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PRACTICAL INSTRUCTION IN ELECTRICITY.

There is no question of greater importance to young men desiring to enter the field of electricity, either as engineers or electrical artisans, than the selection of the proper variety of instruction to fit them for their duties. This country is well provided with schools of the highest class, where electrical engineering is taught from an elevated plane, and instruction given in the mathematical theory of electricity and in its applications. There has been, however, a growing demand for a class of school adapted to the needs of those intending to become practical workers in the field of electricity—for those who are to become artisans and electrical mechanics rather than engineers and professors of these subjects. In another column an article by Mr. C. Walton Swoope tells of the conduct of a school adapted to the needs of this class.

What is needed in the majority of cases is not the elaborate class of instruction given in our colleges, universities and schools of technology, but the hard, practical machine-shop teaching that will enable the young man receiving it to go out after his course is finished and find some work to do which will pay his living. Even after the laboratory course in many of the higher institutions of learning, the student emerges with a degree and knowing much of the more refined side of the subject, but in nine cases out of ten he is ignorant of some of the simpler practical operations, and could hardly be trusted to wire an incandescent circuit or make a properly soldered joint. For this class of student it is not, perhaps, necessary to provide this more elementary variety of practical instruction, but for a large class of young men who form the rank and file of the electrical arts this is just the sort of instruction that is absolutely demanded, and that has been up to the last year or two. It is an encouraging sign to note that a number of schools are being started whose purpose it is to give instruction which will result in turning out intelligent wiremen and electrical machinists who understand the practical manual details of their business. The proportion of engineers has been in the past unduly large, and what we need now is more artisans and more competent skilled workmen, rather than more men equipped with a scientific knowledge of electricity.

ELECTRIC METERS.

The article by Mr. G. W. Donald Ricks, now appearing in THE ELECTRICAL WORLD, shows that the temperature co-efficients of these machines are a great deal higher than had been expected, and that their performance is by no means so good as it should be. Notwithstanding this and other apparent defects of electric meters, they are in many respects very satisfactory machines. They present, however, to the inventor and engineer a most attractive problem, because not one has yet appeared upon the market that does not seem possible of improvement, and none has yet appeared which can be built at a reasonably low price. The problem of designing and building a meter which will be accurate, sensitive, reliable, and in other ways satisfactory, is an easy one, if the cost is unlimited. The problem of designing a good and satisfactory meter at a reasonable price is of a different order. It is one, however, well worth the attention of any who may feel themselves competent to attempt its solution.

CIRCUIT BREAKER VS. FUSE.

In the article in another part of this number, Mr. Joseph Sachs draws attention to the contest between the advocates of circuit breakers and fuses, and shows that each of these methods of circuit protection has its proper place. The fact that such a controversy exists at all is a little strange, when it is considered that the functions of the two instruments are really dissimilar.

To state the case in the simplest way, the fuse has, under all circumstances and conditions, a time lag which the circuit-breaker does not possess. Under ordinary conditions of installations no two pieces of the same fuse will blow with the same current, for the simple reason that a multitude of factors other than the gauge and melting point of the fuse enter the problem. Radiation, conduction from the terminals, etc., profoundly modify the action of fuses, but the fact remains that under definite conditions a fuse is a singularly reliable and very satisfactory protection. The reason is not far to seek. Under steady conditions of radiation and conduction the temperature of a given conductor increases nearly as the square of the current through it. Hence, the limit of carrying capacity can be set with fairly tolerable accuracy if the conditions are definite.

The magnetic circuit-breaker is adapted to a different class of work. It can be set with great accuracy and, if kept clean and properly handled, it is a most reliable and useful piece of apparatus. Lacking the time lag, however, it is a source of much annoyance on circuits where short overloads are the rule, or else is necessarily set for so large a limiting current that its main object is defeated. This very fact differentiates the two methods of protection and gives each a special value. For circuits containing motors whose starting currents are large, or otherwise requiring an abnormal current of short duration at intervals, the fuse is apparently indicated. For steady circuits, having no abnormal loads, the circuit-breaker has the advantages in its favor. The recognition of this very patent fact seems sufficient to end a controversy that, at times, approaches the ridiculous.

RAPID TRANSIT STRUGGLES.

The opponents of the rapid-transit project in New York City are apparently making their last desperate efforts to kill the plans for the carrying out of the scheme. The committee of the Supreme Court is still hearing testimony to decide on the advisability of the city building the road. The plan is for the city to construct the tunnels and structure generally, and to let the contract for equipment and the operation for a long term of years. It is not the Supreme Court committee's business to go into the details of operation and equipment, its function being solely to determine whether the road can be built for the sum of money proposed and without injury to adjoining property, etc. The opponents of the plan have questioned Chief-Engineer Parsons about train weights, speeds, cost of equipment, etc., which questions he has answered unofficially and approximately, having had no occasion to make any exact estimates. This week Mr. O. T. Crosby was called in by the opposition to contradict these approximate estimates. The assumptions made were such as to make the expense as great as possible, such, for example, as train intervals of 45 seconds, etc. In this way an enormous necessary outlay was shown in the attempt to prove that no one would undertake the equipment or operation on account of the expense. As the contract for the said equipment and operation must, according to present plans, be let before the construction is undertaken, this alleged enormous outlay would carry its own penalty and prevent the construction of the road without the aid of outside interference.

THE AIR SHIP AGAIN.

That remarkable apparition, which recently spread consternation in the Western States, and caused much outflow of printers' ink throughout the country, the air ship, has reappeared. This time, instead of hanging as a flaming portent in the skies, it modestly makes its appearance in the pages of one of our electrical contemporaries, and so far forgets that coyness which distinguished its former appearance as to exhibit, not only its portrait, but also to lay bare the secrets of its construction.

It appears that the "De Bausset Dirigible Electric Air Ship" is constructed of a cylindrical body of sheet steel, having conical ends, the whole being 774 feet long and 144 feet in diameter. The air in this cylinder is pumped out, giving it an ascensional force of 400 tons. The other paraphernalia, consisting of a car beneath, containing propelling machinery, weigh in all 69 tons, while the cylinder itself weighs 215 tons. Sixty-six tons of air are left in the cylinder as "ballast," leaving a net ascensional force of 50 tons. The machinery is stated to consist of "engines, dynamos, electric motors, propellers, etc."

How, in these days of the general dissemination of engineering knowledge such nonsense comes to find a place in print, and to be set forth as a scientific and practical design for an aerodromic machine, is a little hard to understand. A few figures will assist in showing the utter absurdity of a design, of which, we are gravely assured, "all details, such as motive power, etc., have been carefully estimated." Let us see.

A cylinder with conical ends, 774 feet long over all and 144 feet in diameter, and of about the proportions shown in the excellent picture of the "air ship," would have about 209,600 square feet of surface; and would, consequently, to weigh only 215 tons, have to be constructed of steel plates 1-16-inch thick, with no allowance for stiffening rings or bracing of any kind. Its own weight, when resting on the ground, would flatten this out like paper. Assuming, however, that it could be made to stand long enough to pump out the air to a 12.5-pound vacuum, the crushing strain on the cylindrical part alone would be over 100,000,000 pounds. The compression strains on the material of the cylinder would be 172,800 pounds per square inch in one direction! The whole thing is so preposterous that it is a waste of time to go further into the discussion of it, except to say that a scheme, similar to this, was first proposed by Francisco Lano, of Brescia, in his work *Prodrome dell' Arte Mæstra*, in 1670. This savant proposed to use copper globes from which the air was extracted, but a little further along Montgolfier found that warm air and Charles found that hydrogen would answer the purpose equally as well as a vacuum, and not inflict upon the machine the enormous strains of atmospheric pressure. These facts might be considered by the promulgators of this air ship with the excellent effect, since hydrogen in their cylinder would give them even more buoyancy than the partial vacuum of De Bausset and Lano.

Copper Produced and Consumed in the United States.

During the first seven months of the present year there was mined in the United States 108,000 tons of copper, this being an increase of 16,000 over that mined during the corresponding period in 1896. This increase was caused by the enlarged demand for both export and home consumption. The amount exported was 78,000 tons, an increase of 9000 over the previous year, leaving an increase of 7000 in this country. As there was apparently very little augmentation in stocks on hand, this 7000 represents very closely the increase in consumption. The present and prospective activity in manufacturing will undoubtedly cause still further increase in the future.

Instruction in Practical Electricity at Night Schools.

BY C. WALTON SWOOPE.

The university extension movement, which has developed to such large proportions during the past few years, has greatly augmented the number and character of courses of instruction available at night time to students of either limited time or means. The result is that now an evening course of instruction in many branches of the arts or sciences is offered by the Young Men's Christian Associations located in our large cities, as well as other leading institutions.

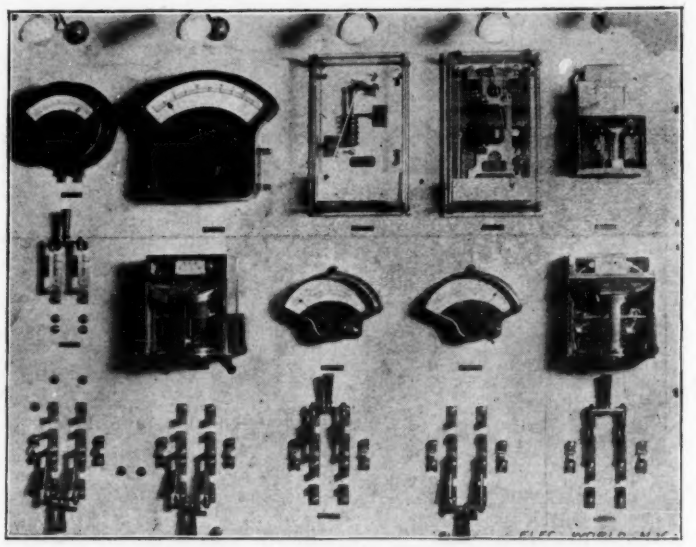
With the rapid growth of electrical industries, and the practical applications of electricity, there has sprung up an urgent and

ELECTRICAL LABORATORY FOR THE USE OF NIGHT CLASSES.

increasing demand for night courses in electricity, so that lecture courses are now given quite extensively.

A course in practical electricity has been developed at the Spring Garden Institute, Philadelphia, which has met with such a measure of success that its features may be of interest to others engaged in this work. This institution is the home of the manual-training system of instruction, and one of the first to offer such instruction to night pupils. At present the institute maintains day schools in three distinct departments—art, mechanical, and electrical—and each department has night classes.

Elementary and advanced lecture courses in practical electricity have been established for several years during the winter season, each class attending two nights per week and receiving about fifty lessons per year. The amount of ground covered in this time is considerable, the subject being treated thoroughly

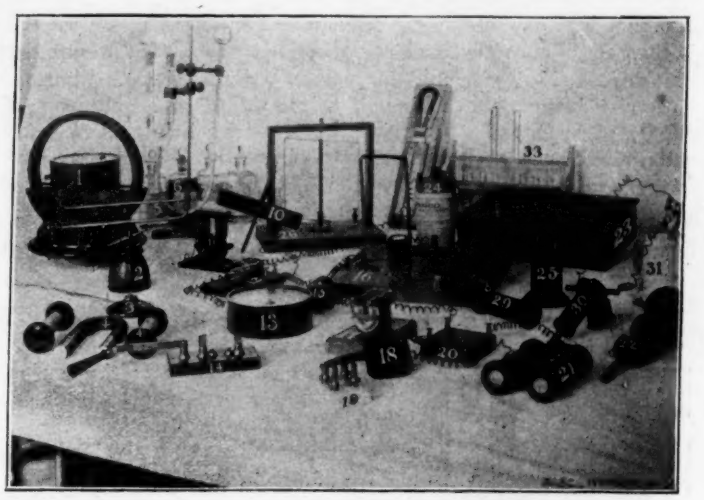


THE SWITCHBOARD.

from a beginner's standpoint, and well illustrated by experiments, lantern slides, syllabus, etc. The popularity of the subject may be judged by the yearly enrollment of from 100 to 150 students, ranging in age from twenty to thirty-five years, and representing many of the vocations of life.

The feature of the past year has been the individual laboratory work performed by each student of the class. The elementary principles of electricity and magnetism admit of being illustrated by several hundred experiments, so it became necessary to equip a laboratory, capable of accommodating 100 students, with elementary sets of students' apparatus which would meet all requirements. Such an outfit is not furnished by any electrical instrument maker, so one was organized which would be adapted to a beginner's use, and still be efficient enough to give satisfactory results. The key to parts of set illustrated in the cut will give some idea of the apparatus used in the course. As an instance of the flexibility of the instruments, Fig. 17 of the cut illustrates a small glass *U* tube clamped, by a rubber band, to a block of wood with suitable terminals. With the proper selection of electrodes and chemicals many types of cells can be experimented with, in connection with the galvanometers; it also serves as an accumulator and a voltameter, and again as a calorimeter, by inserting a spiral of iron wire in the tube; without the tube it is used as a fuse block for studying the effects of currents on metals.

The detector galvanometer, when placed in the tangent coil frame, with its multi-coils, forms an efficient apparatus for studying the laws of circuits. Electro-dynamics is illustrated by the form of Ampere's frame shown in 10 and 26, and electromagnetic induction by the plunging of a bar magnet (27) in the secondary coil (25) which gives some twelve deflections of the galvanometer needle. In the laboratory a 250-volt direct-current power circuit and accumulators are used for many experiments. A se-



PART OF THE STUDENT'S SET.

1. Tangent Galvanometer.
2. Oersted Stand.
3. Poised Magnetic Needle.
4. Iron Core and Spools of Electromagnet, No. 21.
5. 6, 7, 8, 9. Chemicals used in Voltaic Electricity.
10. Solenoid for Ampere's Frame, No. 26.
11. Small Dynamo and Motor.
12. Students' Double Contact Key.
13. Detector Galvanometer.
14. Single Pole Switch.
15. Resistance Spool for Wheatstone Bridge.
16. Wheatstone Bridge.
17. Students' Cell.
18. Commutator Switch for No. 20.
19. Double Pole Switch.
20. Mercury Commutator.
21. Electromagnet.
22. Core and Spools of the Induction Coil. (See 25 and 30.)
23. Adjustable Resistance Box.
24. Dry Cell.
25. Secondary of Induction Coil.
26. Ampere's Frame for Studying Magnetic Effects of the Current.
27. Students' Bar Magnet Set.
29. Solenoid.
30. Primary of Induction Coil.
31. Daniell Two-fluid Cell.
32. Students' Gas Voltameter.
33. Test Tube Rack.
34. Resistance Spool Set.
35. Jumping Spiral.*
36. Gravity Ammeter.
37. Gravity Voltmeter.
38. Calorimeter.
39. Two Incandescent Lamps and Receptacles.
40. Potentiometer Wire.
41. Inductorium.

*Apparatus from 35 to 41 is not illustrated in the plate.

ries and multiple line are run to all benches, and each student supplied with a switch inserted in the series circuit, and a tap from the multiple line through a switch. Whether the instruments be operated in series or in parallel, each student has complete control of his own current. The series line is found to be very convenient when large currents are to be supplied, as thirty-five amperes for the circular field of a wire or for induction effects, etc.

In calibration work, such as a solenoid ammeter (combination of 30-32 and a brass spring, pointer and scale), all students work together, in other experiments independently, but the same experiment at the same time. In the advanced work some rotative tests are introduced, as the number of men to be handled is much smaller. A specially printed laboratory notebook is provided, in which each student keeps a record of experiments made, and at his leisure fills out the results and inferences drawn from the same. Each lecture night is succeeded by a night in the laboratory, which also affords a means for slight individual instruction not possible in the lecture hall.

Electrical arithmetic has proved to be an attractive feature, and in order to give deficient students the necessary ground work an optional class in mathematics meets one night per week. Students who show the proper efficiency are awarded certificates at the end of the year; to make them of some value the examination questions are printed on the back thereof, and from inspection will show the practical character of the course. Students of the advanced class are required to go on duty in the institute's lighting plant, which is designed especially for instruction, and make out and return a report of the run, containing numerous practical calculations.

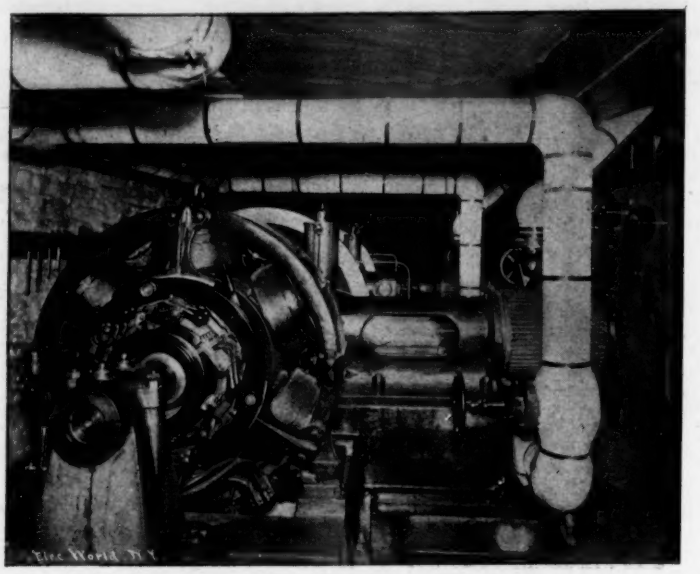
Lecture experiments are supplemented by the arc projection lantern, which forms a valuable adjunct to the course. Beside the regular slides, many diagrams and problems will be found useful, and can be readily and quickly made by first writing or drawing upon gelatine film cut the size of the slide. The edges of a piece of crystal glass, the same size, are protected near the upper and lower corners by small pieces of slide binding, and two rubber bands stretched horizontally across the glass; the film is thus readily inserted and removed, and a box that would hold one dozen slides will hold more than a hundred such films. A lantern galvanometer, or combined ammeter and voltmeter, as suggested by Fleming, permits of many tests being made before a large audience, and such other projected experiments, as making magnetic fields, electrolysis, voltaic action, arc craters, etc., prove highly instructive, as well as entertaining. In many instances the mirror reflecting galvanometer, with large scale, will be found useful.

A Modern Electrically Driven Printing Establishment.

THE operation of printing machinery was among the very earliest practical applications of the electric motor. Even as then arranged its vast superiority was highly appreciated for the driving of such machinery, but it could scarcely be considered as more than a substitute for some other form of motive power over which it possessed, perhaps, many advantages, but yet required very much the same application and connection to the driven member. The peculiar flexibility of electric power, permitting of ready individualization and independent operation of each separate unit, soon indicated the desirability of operating each unit by means of a separate motor mechanism instead of group operation. The peculiar advantages of individual driving are in no class of work more forcibly manifested than in the operation of printing presses. Frequent stops and starts, varying speeds, and the necessity for positive control, are but poorly realized with belt driving from a single power unit. Aside, however, from these considerations, and even neglecting efficiency, the elimination of belts and shafting in an establishment of this kind is highly desirable.

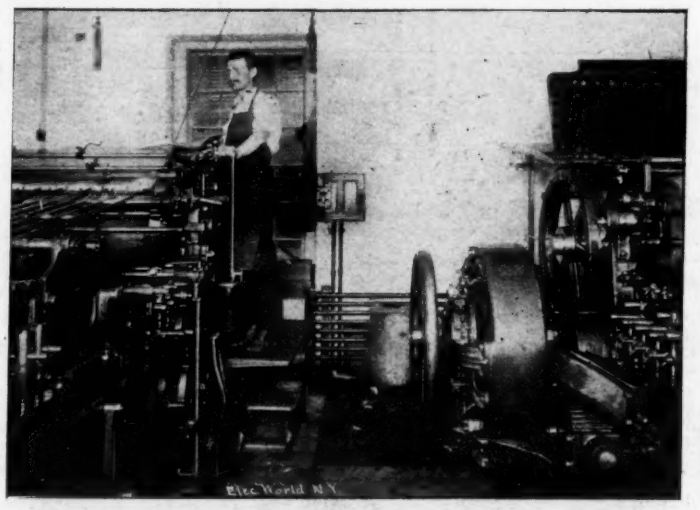
Single motors belted to each machine in a measure fulfilled many of the desired requirements. It is, however, only within recent years that it has been attempted to apply the electric motor directly to the driven member of press machinery without the intervention of intermediate gearing. The difficulties involved in the successful accomplishment of this result will be best appreciated when the peculiar power demands of nearly all classes of printing presses are considered. The power line of such machinery takes the form of a very uneven curve with a constant succession of periodic cycles, during which the power varies from that merely necessary to move the various parts of the machine to the maximum required at each impression made by the type on the paper sheet. With the larger classes of printing presses this inherent feature is not only prominent, but has, perhaps, been one of the main difficulties connected with the direct application of the motor, and has made some flexible connecting link desirable, if not advisable. Probably, however, the extremely slow speed required to satisfactorily effect such a combination is equally notable.

Decided progress has been made within the past two or three years in building motors for this class of work. The large up-to-



The Generating Plant

date pressroom of to-day is indeed a revelation to the printer of years ago. Machines of the largest size, immense octuple cylinder Hoe newspaper presses, are directly geared to single motors of moderate speeds. It has as yet probably been found inexpedient to directly connect the driving member of the motor directly with the driven press member. For the sake of motor efficiency, size, and weight, this combination can be best effected by a geared or belted connection. With the cylinder type of press, however, which is not quite so gigantic, this arrangement has proven entirely successful, and is accompanied by a multitude of advantages. Presses of this type, taking from 1 to 12 horse-power, are fitted with such driving motors with scarcely any perceptible additions. The motor attached to one side of the machine be-



Direct-Coupled Motor and Controller.

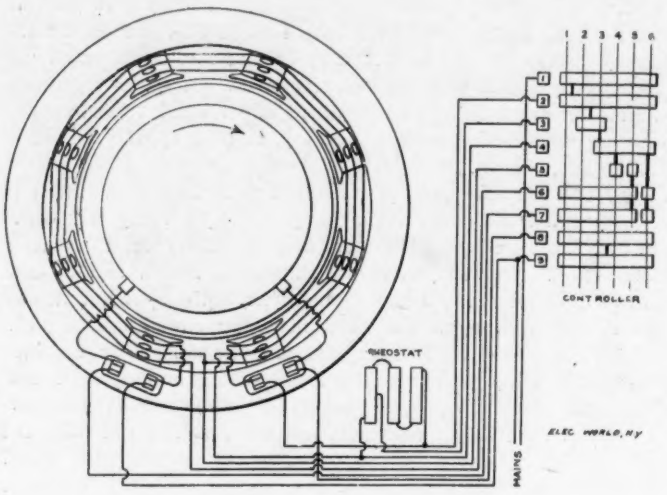
comes a part of the machine itself, which is then an absolutely self-contained piece of mechanism, controlled and operated with the highest degree of nicety and precision, by means of a small controller, handled, as a rule, by the feeder.

A recent installation of this type, including at present about sixteen direct-connected units, is, perhaps, of particular interest, as it forms the nucleus of a plant which will shortly attain about four times its present proportions. This installation has been put in at

the new printing rooms of M. R. O'Loughlin & Co., printers for the Butterick Publishing Company, on West Thirteenth street, New York, by the Crocker-Wheeler Electric Company. The motors are all of an improved multipolar slow speed type, and are fitted in the manner above described to fifteen old presses of various sizes and kinds and one heavy paper cutter.

The press equipment includes:

Three two-color Huber cylinder presses.
Seven single Huber cylinder presses.
One Miehle cylinder press.
Four Whitlock cylinder presses.
One Scott cylinder press.

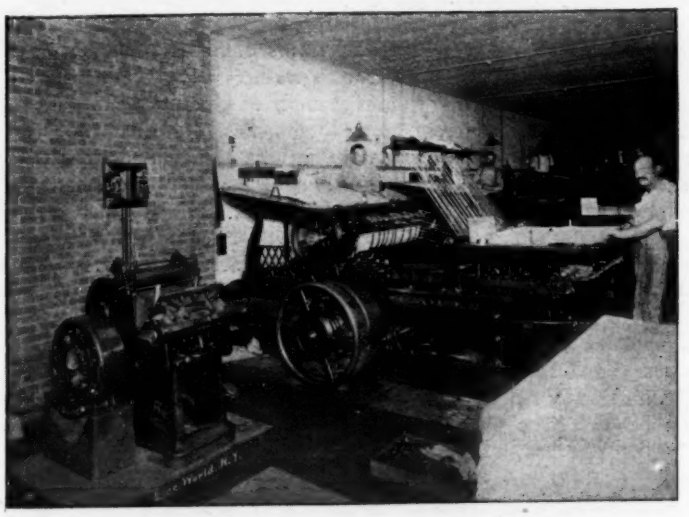


CONTROLLER DIAGRAM

One Brown & Carver cutter.
One quarto Universal.

These presses are operated by motors ranging in size from 1 horse-power to 7.5 horse-power, and aggregating about 75 to 80 horse-power. Two direct-connected generating units located in the basement of the building comprise the present power plant. Each consists of a Crocker-Wheeler multipolar 50 kilowatt compound wound 230-volt generator, direct coupled to a simple horizontal Paine engine, operating at 265 r. p. m.

The present switchboard is equipped with the necessary dynamamo switches and measuring instruments, and also with a street-service switch connection. From the board two feeders extend, one for lighting the building and the other for power



MOTORS DIRECT-COUPLED TO SMALL AND LARGE PRESSES.

purposes. The latter divides, each branch extending to its respective row of presses, the entire equipment being ranged in two almost equal rows along each side of the pressroom. The pressroom is on the second floor. Wires are run from the main on the ceiling of the floor below in iron armored conduit to the controlling switch, and cut out on the wall opposite each press, from which point the wires extend again in iron armored conduits to the press motors. Each motor is protected, in addition to the fuse cut out, by a circuit breaker. This latter cut-out device has been installed to meet the requirements of the New York Fire Department Inspection Bureau. Its exact value for such service, is, perhaps, somewhat doubtful. As will be seen from the illustrations, the motor is attached to one side of the press, while the operator, who feeds the sheets and works the controller, is at the other side.

Several new features are embodied in the motors used in this plant. They are of an 8-pole type, with cast-iron circular exterior frames and wrought iron internally directed pole pieces. The armature is of the drum-wound ring type, having a very large many sectioned commutator, and without inter-connection, each field system having separate brushes. The designers of these machines have adopted a system of rating which is peculiarly satisfactory for this class of work. The plan adopted consists in rating each motor at the horse-power given at 100 r. p. m. For instance, the 2-100 motor gives two horse-power at 100 r. p. m. As is quite obvious increase of speed is permissible, increasing thereby the motor output and also efficiency. The Buttterick installation includes at present the following motors:

Number.	Size.	Output. Hp.	Speed. R.p.m.	Weight. Lbs.	Armature. Diameter. Inches.	Poles.
1	½–100	....	....	....	....	....
1	1–100	3	266	520	15	6
3	2–100	5	180	890	19	8
		2½	130			
10	3–100	3⅝	125	1,075	21	8
		7½	210			

It is certainly to be expected that at the low-speed outputs the motors are somewhat heavy for their capacity, and certainly less efficient than at the higher speeds. Tests at this installation show that for the 7½-hp output of the 3-100 motors at 210 r. p. m. an efficiency of about 75 to 80 per cent. is obtained, which diminishes as the speed is decreased.

A somewhat novel arrangement has been adopted in the control of these motors. With the intention of combining the advantages of a shunt-wound motor for running and series winding for starting effects these motors are compound wound, but the series field winding is in two sections, and is only used in starting, being cut out as the controller is moved forward. The controller consists of an insulating half cylinder, on which are mounted various connecting contact blocks, co-acting with a row of stationary contact brushes parallel with the axis of the cylinder. The spindle of the contact cylinder extends upwards to within easy reach of the operator, in the form of a steel shaft terminating in a handle, which may be moved in either direction, corresponding to the desired back or forward motor movement. The various forward speeds and combinations of field and armature connections will be seen from the diagram, which shows a plotted cylinder. Only two steps are arranged for the opposite or backward movement of the motors. The necessary reversing connections are made on the cylinder, no separate reversing switch being used.

It will be noted that, in starting the motors the shunt field is connected, and the armature, both series-field windings, and a resistance are in series. Following steps first cut out half, then all the resistance, one series winding, then the other, and finally leave the motor running as a shunt motor at its maximum speed. This arrangement apparently gives very excellent results, as the presses start very regularly and evenly, and without serious starting-resistance losses. A notable feature is the absence of brakes for stopping the machines. Almost instantly on turning off the current at the controller cylinder the motors are brought to stop.

The individual power unit in printing establishments, as here exemplified, will surely effect, and has already shown, many economies and decidedly pleasing conditions, by no means the least of which is safety. One who is familiar with the maze of belts, shafts, etc., so prominent a feature of the printing shop of only two or three years ago, will be somewhat amazed at the present aspect. Apparently another promising field is dawning for the electric motor.

Is the Fuse or the Circuit Breaker Best Suited for Motor Protection?

BY JOSEPH SACHS.

With the earliest commercial development of constant potential varying current systems of distribution, it at once became apparent that some means must be provided whose function would be to act as a safety cut-out, preventing undesirable results due to excessive flow of current. Those who successfully exploited the pioneer multiple distributing systems found the simplest and at the same time by all means the best method of protection in the utilization of that heating effect of the current, against which the distributing system and translating devices were to be protected. The safety fuse may well be said to have been one of the main factors in the successful development of such systems. Other means, as now, were then available to accomplish similar results, among which electromagnetically opened switches or circuit breakers were the most promising. To the early electromagnetic circuit breakers, at least as applied in some instances, the verdict "tried and found wanting" was justly applied. Later, with the introduction of the electric railway, their value was better appreciated, and to-day they are extending their operations to pastures new, and the poor fuse is having a hard time of it.

Perfect by no means, it is, however, perhaps more sinned against than sinning. Not only are its capabilities attacked, but in a recent article we are informed "that it has been a most important factor in the development of electric-power transmission and electric lighting, it is true; but when one considers that the various systems of arc lighting were developed without its use in them, it has by no means been the critical feature of electrical development. On the other hand, the magnetic circuit breaker in some form or other has been in use almost from the very inception of modern electrical development." Unquestionably "the various systems of arc lighting were developed without its use," but somehow or other "the magnetic circuit breaker" which "has been in use from the very inception," etc., also seems to be sadly absent, for the simple reason that neither of these appliances, or any others with a similar function, could be utilized as a protection against an excess of current where no such excess is supposed to exist. The writer and at least, he believes, some others, have always understood that the arc-lighting machine and its auxiliary regulator usually took good care (or at least was intended to) that there was no such excess. Excess or no excess, however, the utilization of a fuse in an arc-light circuit, with the possibility of its blowing while the machine was fully loaded, from some cause or other, would probably present a very unique condition of affairs, and could quite aptly be considered as a very flashy pyrotechnic display. It might not be advisable to have this display indoors or to watch it too closely.

Electromagnetic switches and circuit breakers are old. So are strips of fusible metal which melt and rupture the circuit when overloaded with current. Is it, however, not a fact that from the very earliest practical necessity for such protection up to even the present time, at least in the vast majority of instances, the much-maligned safety fuse in many respects resembles the English costermonger, whose peculiar characteristics have been immortalized in the ditty which, among other things, says: "'e's all right if yer knows 'im, but you've got to knows 'im first"? Much has the poor safety fuse suffered. In many respects not unjustly, but do its accusers mean to say that the circuit breaker can do better in every case? There are even those who claim that the time is coming when the safety fuse as a protective medium for electrical machinery will be relegated to the museum of electrical antiquities. Many, however, are somewhat more liberal and rational, and say that it still has its uses, but that it should preferably always be under the protection of a circuit breaker. For some uses the circuit breaker has, however, been particularly advanced as the sine qua non of protection. The compilers of recent inspection regulations and several investigators who have diagnosed the relative merits of both protections, have probably neglected to fully consider their best and most effective practical application, and seem to place most implicit faith in the use of electromagnetic circuit breakers for the protection of stationary motors, claiming that for this purpose the use of such devices far surpasses in efficacy the use of the fuse. Does the electromagnetically operated circuit breaker really surpass the fuse in actual effective, practical everyday motor service?

Let us slightly consider the peculiarities and capabilities of both appliances. In the case of the fuse cut-out we may well agree with the following general deduction, also included in the previously mentioned article, whose author, as will be seen, has arrived at these conclusions after a series of tests and experiments, "as a summary, not of opinion, but of the evidence of actual tests, a fuse of the proper length and exposed to the air, properly placed in its receptacle, and mounted on copper terminals, will do excellent service, both as regards regularity and reliability, except where small time constants may be of importance, but constructed as it may be it will always have one fault, its time constant is large, and, except for normally excessive currents, will be slow in opening the circuit. Yet this peculiarity renders the fuse of special service in certain cases where a temporary overload is a necessity, and the apparatus is constructed to withstand it." The author of this paper leans rather in the direction of circuit-breaker protected motors as indicated by: "In general practice a motor should be protected by a magnetic circuit-breaker." As already stated, his view is shared by others, who apparently have not profited by the above conclusion, and do not quite appreciate that motor service may well be classified under those "certain cases where a temporary overload is a necessity, and the apparatus is constructed to withstand it."

In view of the above concise statement as to fuse capabilities, it is probably unnecessary to give in this paper any lengthy consideration of fuse shortcomings. These are almost entirely due to fallacies of construction. Well may it be said, however, that were the same amount of development and improvement expended upon the fusible cut-out as has been upon the electromagnetic circuit breaker, the fuse would not be subject to such general criticism, for, as a matter of fact, it inherently possesses the elements for more precise and effective operation under proper conditions. It remains but to properly and most effectively make these features available and to guard against and eliminate as far as possible the exterior conditions which affect them. The safety device whose effectiveness varies almost with the square of the current certainly must be acknowledged superior to one which must have twice the current in order to have twice the operating tendency.

There are probably 101 different arrangements of fuse blocks and fuses, and in probably no two instances are the relative arrangements exactly alike, yet we buy, for instance, link copper terminal fuses of a certain length and capacity and use them indiscriminately in blocks with all sorts of contact terminals, arranged in many fashions, and exposing the fuse to a variety of exterior conditions, all or any one of which may affect its operation. Why not standardize fuse cut-outs? Not a fuse wire or the holding-block alone, but consider both as one device. Let the radiating surface, length, terminals, contact clamps or holders, insulating holding block and location of fuse on the same, surrounding medium, non-interchangeability, prevention of flash and the throwing of molten metal, all be considered. The manner in which these elements should be treated has recently been quite thoroughly discussed. Certainly there seems to be no serious difficulty to prevent improvement in all of the above directions.

There are places where the present forms of fuses would be objectionable. In places with great temperature changes, or where great fire risks exist, a fuse of entirely different type must be available to be of effective service. The flashless inclosed fuse has features which have led the writer to believe that in this direction superior results may be obtained. Such a device was devised by the writer some years ago. It has given excellent results, and can be built to accurately rupture high-potential and wattage circuits in a manner that would create a most envious feeling in the circuit breaker.

Electromagnetic circuit breakers, as at present constructed, on the other hand, are by no means beyond criticism. No doubt we have in such appliances an automatic cut-out which can be easily set and adjusted, remains almost unchanged after adjustment, can be readily reset without any renewals of parts (if the arc is prevented from getting the best of the switch blades), which is accurate in operation, retains its accuracy, and whose sluggishness is reduced to a minimum. In regard to the last feature, the manufacturers vie with each other in claiming instantaneous operation. Just as easily as it can be adjusted and set it can be reset in either direction within the limits of the device. We are told about the refusing (?) of fusible cut-outs with No. 10 copper wire, nails and bars of solder, where the previous strip consisted of probably a No. 15 fusible lead wire. This condition of affairs is to be deplored, but it certainly does not entail any great hardship on the expert who perpetrates this, whether through ignorance or otherwise, to give the adjusting screw of the circuit breaker a turn or two and set it to suit his ideas. If the apparatus finds it impossible to obey the wishes and desires of the adjuster,

owing to its limited maximum capacity for current, a short piece of cord soon reduces it to a condition when it no longer objects to too much. This is not an unusual occurrence, although perhaps somewhat extreme.

A circuit breaker, if well constructed and set to operate at a certain current, is intended to open at that current at any and all times. It will usually do so, and not take into consideration the fact that this maximum opening current may last but for an exceedingly short interval. There are conditions, as, for instance, the protection of dynamos with unlimited power behind them, where this action would be highly desirable, not to avert disastrous results due to heating effects, but to sudden, we may say, electro-mechanical strains. Where we are guarding, however, against an excessive $C^2 R$ effect in the conductors or translating devices, would it not be well to be somewhat patient and find out first whether the current is going to last long enough to do any harm, and to then open it before it does? Present circuit-breakers have not the happy faculty of using judgment in these cases. Why not build them so that they will. A time-interval circuit breaker, preferably with this feature adjustable, is a highly desirable piece of electrical apparatus. It is coming, and its début has already been promised by several. Yet a fuse already does this, and is simple and much cheaper. Why not make it at least approximately as accurate as the breaker?

Is it advisable in view of the peculiar features of the fuse and the magnetic circuit breaker to use the latter for motor protection?

If a circuit breaker is installed and set for a small safe percentage of overload current the breaker is a most excellent protector; it opens too often. A rush of starting current, a sudden load will throw it. Yes, but the circuit breaker is built to operate at these rushes. The motor, however, is not built to be injured by them (if it is a good motor), and the owner of the motor soon discovers that it is highly desirable to increase the overload margin of the breaker. It does not open then (if he has set it high enough to eliminate the previous difficulty), but what an excellent (?) protector for that particular motor it then becomes. Set at a point where it will not open at these momentary rushes, it is probably beyond the safety-time current point. A short momentary rush would not hurt that motor, but a continued current, perhaps one-half or less of the momentary rush, will. The circuit breaker turns a deaf ear to the appeal for aid from the motor, and waits for the fuse to blow (if too much reliance has not been placed in the breaker and the humble fuse ignored).

It is quite true that those who advocate circuit breakers for motor protection usually advise as follows: "Neither device should be employed to the exclusion of the other." Why have the circuit breaker when practical conditions make it useless? Why not improve the fuse and make it accurate? We are told, for instance: "The writer has a 20-hp motor which formerly was protected with a fuse. On two occasions, owing to a fault in the stop-cock of the oil reservoir at the pulley bearing, the box heated and melted out the babbitt, letting the armature down on the field. The fuse eventually opened the circuit, but not until considerable damage had been done to the armature. In such a case as this, a time constant in excess of a second is a disadvantage. The fuse is now discarded in favor of an accurately set circuit breaker. This has never yet given trouble in starting up the motor, and as the motor operates a large number of woodworking machines and several long lines of shafting, it can fairly be taken as a typical case." In another case a motor was equipped with a circuit breaker and operated a direct-connected printing press. Through accident the dress of a female attendant was caught in the gearing of the press, and the clogging of the gear and the consequent increased load threw the circuit breaker, preventing bodily injury to the attendant.

Do either of these instances show that the circuit breaker is superior to the fuse as a safety cut-off? Is it essential to provide against the unusual accident? In saying that a circuit breaker does not open with the starting or during the operation of the motor operating various machines, it may be well to know whether the motor starts with load (it probably does not in this case), whether its rated capacity corresponds with the load, and whether the circuit breaker is set for an overload percentage above the former or the latter. If set for, say, 25 to 35 per cent. above the rated capacity of a 20-hp motor, the assumption that something would drop in case of the circuit breaker as well as the fuse, if the same condition of affairs reoccurred, is probably not erroneous. In this case it might be well to properly set the motor, and then, perhaps, neither fuse nor circuit breaker would be expected to open except from legitimate causes. The other instance is far more serious. Every preventive against such an accident must certainly be provided. But then our protective device has quite another function. Its main object is no longer motor protection. The satisfactory operation of the motor is held secondary to accident prevention. Certainly, with such an adjustment of the breaker as must have been the case in the instance cited, any other equal overload would produce similar results, and in some instances it may be desirable to prefer this arrangement. We are then, however, guarding against the extraordinary in this particular case. Where the motor current rarely exceeded its normal-rated capacity under working conditions and such danger existed, this may be by all means the most approved arrangement. If, however, the current frequently exceeded this point, and momentarily reached even above the safe time-operating current, the point at which it would be essential to set the circuit breaker to produce effective operation would eliminate all chance of it serving near as well as an accident prevention as the fuse set for a smaller overload current, with perhaps a slight time interval.

The writer's actual experience with circuit breakers on motors, used in a very large number and variety of applications which have come under his examination, indicates that if any form of circuit breaker is adopted a highly desirable feature would be to make it proof against any readjustment after once set, and also tying up. In every case where the motor is loaded to almost its full capacity, with a possibility of a temporary overload above the circuit-breaker setting, the breaker is either set up or tied up. One is almost as bad as the other.

It would hardly be correct to consider the circuit breaker as "a step backwards." It gives excellent service under certain conditions, even in its present form, and is an exceedingly excellent and important electrical mechanism, but when it is intended to protect an electric motor from overload current let us have the properly-designed fuse. An instantaneous circuit breaker will do where the maximum working is almost even with the maximum-rated current, but where there are apt to be short interval peaks reaching, perhaps, several times the height of the maximum safe working current, let us have time interval devices.

Fowler's Electro-Plating Secret.

To the Editor of the Electrical World:

SIR—This dying and carrying into the grave a secret, as in the case of Mr. Herbert E. Fowler, at Naugatuck, Conn. (mentioned in THE ELECTRICAL WORLD of August 14) is very, very sad. It is probably a heredity—a survival of some custom of our ancestors, like burying the stone hatchet, or the pipe, and bows and arrows of the warrior, that he might have them handy in case he wanted a smoke or should see a duck or a bison on his way across the River Styx.

Mr. Fowler knew, and refused to divulge, the secret by which electro-plating on wood, etc., could be accomplished, and the liquid preparation, too, it is probable he destroyed. There is much in all this profound wisdom that somehow reminds one of the country doctor who prescribed a decoction of "*Eupatorium Perfoliatum*" for an old lady who, on tasting the decoction, remarked: "Well, if the doctor hadn't said what it was, I'd engage it was just boneset tea."

In Fowler's case, if a zinc solution is substituted for the "liquid preparation" the secret is an open one, known in electrical chemistry for years.

C. C. HASKINS.

American Street Railway Association.

Mr. T. C. Penington, secretary of the American Street Railway Association, is sending out a circular letter to those interested, reminding them that the sixteenth annual convention of the association will be held at Convention Hall, Niagara Falls, N. Y., October 19 to 22, inclusive. Mr. Penington states that papers from well-known authorities on electrical subjects will be read, and that there will be a fine exhibition of railway appliances, every foot of space available having been engaged for this purpose. The headquarters of the association during the convention will be at the International Hotel, at which place the annual dinner will be given on Thursday evening, October 21, at 7:30 o'clock.

Some Tests on the Variation of the Constants of Electricity Supply Meters with Temperature and with Current.—III.

BY G. W. DONALD RICKS.

PERRY METER.

The general principle upon which the action of this meter depends differs from that employed in the Chamberlain and Hookham meter in several respects. Instead of the current passing radially through a permanent magnetic field, the field is radial and the current traverses it perpendicularly, the chief retarding force being due to Foucault currents. It was in this meter that complete immersion of the armature was first used.

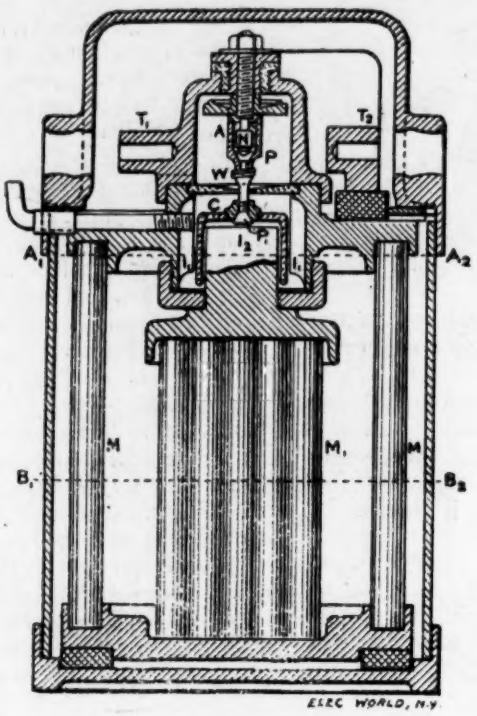


Fig. 7.

In the sectional drawing, Figs. 6A and 6B, M M_1 are a number of permanent magnets, their pole-pieces I_1 I_2 being so shaped that they form the boundaries of an annular chamber, S S, containing mercury.

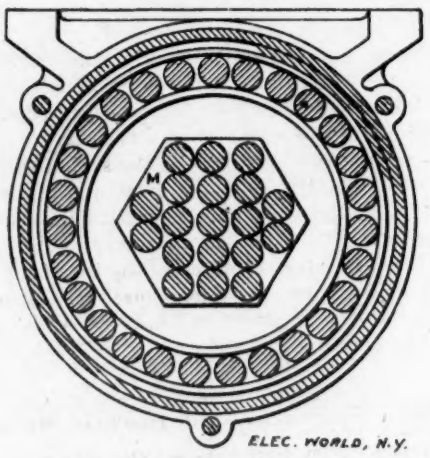


Fig. 8.

In this chamber an inverted copper cup, C, rotates on a vertical spindle pivoted at P and P_1. The pivot P is placed in a small mercury cup, A, thus insuring good electrical contact between the fixed and moving parts of the circuit. The whole surface of the spindle and copper cup, except the rim at the bottom, is insulated from the mercury by a coating of enamel. The current on entering at the terminal T_1 passes to the bottom of the mercury chamber; then up through the cylinder and spindle to the small mercury cup A, into which projects the nickelled rod N, insulated from the case, but connected to the other terminal, T_2, by which the current leaves the meter.

Solid friction is not compensated for in this meter, but is made very small compared with the other forces, by so adjusting the weight of the copper cylinder that it just floats in the mercury. There is also very little skin friction, because of the very small diameter of the spindle at the part where it passes out of the mercury. In order to make the Foucault friction as large as possible, discontinuities D_1 D_2 (Fig. 6C) are made in the pole-pieces; but the cylindrical form of the mercury chamber is preserved by filling these up with plaster

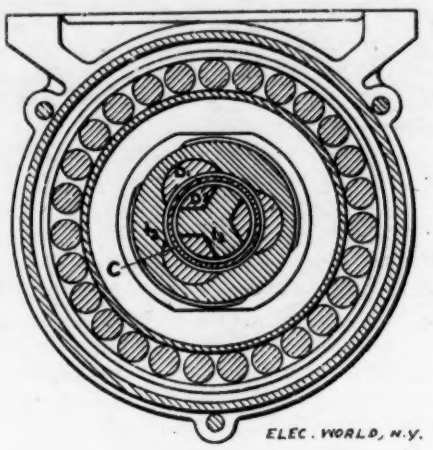


Fig. 9.

of Paris, the aim being to make the retarding force due to Foucault currents large compared with the other retarding forces—viz., that due to the friction of the mercury against the sides of its chamber, and the solid and skin friction of the spindle.

In considering the law of this meter, let

A = the current,
F = strength of permanent magnetic field,
T = the driving torque,
w = the angular speed of spindle.

Then $T = c\,A\,F$ where c is some constant.

Now the frictional resistance is made up of three parts:

(I.) Solid friction at the bearings and skin friction where the spindle passes out of the mercury. Let r equal their combined retarding force; the law connecting r with the speed w is not at all definite.

(II.) Fluid friction of the mercury on the copper cylinder and on the walls of its chamber. This is an exponential function of the speed, the exponent increasing with the speed. Let a (w) be the retarding force due to this cause.

(III.) Foucault current friction. This is very nearly proportional to the speed and to the square of the strength of the magnetic field, and may therefore be represented by $b\,F^2\,w$, where b is some constant.

Hence for steady motion we have

$$T = c\,F\,A = r + \varphi\,(w) + b\,F^2\,w.$$

Now the construction of the meter is such that the term $b\,F^2\,w$ is very much greater than the sum $r +$ a (w). As already mentioned this is effected by using a strong permanent magnetic field and by reducing solid and fluid friction to a minimum.

Hence we have that very approximately $c\,F\,A = b\,F^2\,w$,

$$A = \frac{b\,F}{c}\,w = k\,w, \text{ where } k \text{ is some constant.}$$

The experimental results obtained from this meter are given in tabulated form in Table IV., and shown graphically on Curve IV.

The high value of the constant at low currents is undoubtedly due to relative importance of solid and fluid friction as compared with Foucault current friction, for, as already mentioned, the former are not compensated for, and in the equation of motion are assumed to be negligible compared with Foucault friction.

Above about 30 per cent. of maximum current the constant begins gradually to rise, owing possibly to the increased effect of fluid friction, which increases very rapidly with the speed.

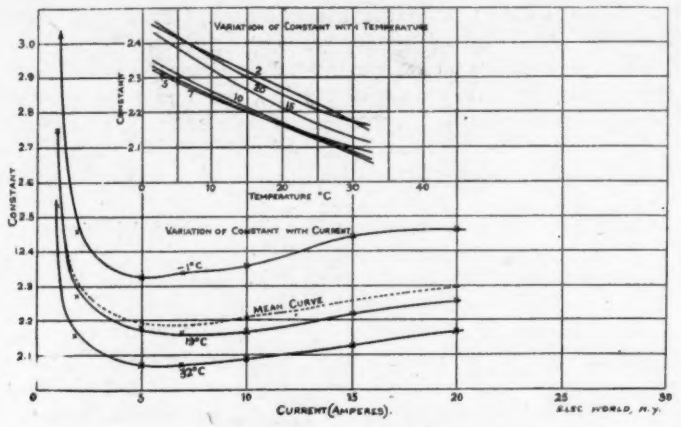
The effect of temperature, as shown also on Curve IV., seems to

be considerable. The constant decreases in value with rise of temperature, the mean coefficient being 0.47 per cent. per 1° C. change of temperature. It may be accounted for by the decrease in retarding forces, due partly to the increased resistance of the copper cup, and consequently smaller Foucault current friction, but probably also to the decreased viscosity of the mercury reducing the fluid friction.

TABLE IV.—PERRY METER.

Maximum current 20 amperes. Current varied. $a = 660$. $K^1 = 2$.

Current A.	At −1°C.		At 19°C.		At 32°C.	
	w	K	w	K	w	K
1	0.0607	3 022	0.0685	2.677	0.0724	2.534
2	0.1493	2.456	0.1613	2.271	0.1700	2.152
5	0.3950	2.320	0.4210	2.180	0.4432	2.069
7	0.5490	2.341	0.596	2.155	0.630	2.070
10	0.779	2.356	0.847	2.166	0.875	2.096
15	1.126	2.442	1.241	2.215	1.296	2.121
20	1.490	2.460	1.640	2.256	1.690	2.170



CURVE IV.—PERRY METER.

The weakening of the permanent magnets with rise of temperature would scarcely have any effect on the constant, because it would, except perhaps at very low currents, alter the driving and retarding forces in almost the same ratio. The inaccuracies of this meter with variable temperature are rather large. An alteration of 10° C., for instance, causes an error of 4.7 per cent., which is rather serious when it is remembered that the Board of Trade has fixed the maximum permissible error at 2½ per cent.

Although possessing such a high temperature coefficient, this meter has several very desirable properties, among which may be mentioned extremely low resistance. Delicate counting mechanism is avoided by having a large brake force; extremely delicate registering gears are very troublesome to keep in order, and will stand only the most careful usage. The use of exceedingly pure mercury is not so essential in this meter as it is in those which rely on mercury for fluid friction. Fairly pure mercury is used to reduce the fluid friction to a minimum.

The permanency of strength of the magnetic field is secured by energizing the magnets after they are in position, and then slightly weakening them. The strength of field is adjusted by replacing one or more by pieces of wood until reduced to the required strength. The construction is throughout very compact and durable, and the manner of making connections very convenient.

CHAMBERLAIN AND HOOKHAM METER.

In this meter two metal discs are employed rotating upon a vertical spindle in a permanent magnetic field, the direction of which is parallel to the spindle. The current in passing radially through one of the discs gives rise to a driving torque, which, since the field is constant, is directly proportional to itself. A retarding torque proportional to the speed is supplied by Foucault currents in the other disc.

In the sectional drawing, Fig. 7, $M\,M$ are permanent magnets enclosed in a brass tube, T. The pieces $E\,E_1$ and the wrought-iron pillars $W\,W_1$ continue the magnetic circuit to the pole-pieces $P\,P_1$, between which there is a wrought-iron piece, L. This is held down upon a copper ring, R, which lies upon the flat surface of the lower pole-piece P and forms with it a mercury chamber in which the driving disc D rotates. The inner surface of the ring R is nickel-plated to prevent injury from the mercury. The brake disc D_1 rotates in the gap between L and the upper pole-piece P_1, both of which are deeply grooved radially to increase the Foucault current effect. This grooving also has the effect of reducing the area of cross-section, causing the projecting radial bars to be partially saturated, the result being that the strength of the brake field is almost independent of the total induction. Besides the retarding force on the brake disc, two other retarding forces are present, namely, that due to fluid friction of the driving disc on the mercury, and that due to solid friction at the bearings and in the counting mechanism. These are all made as small as possible, and are practically negligible compared with the brake friction.

Solid friction at the bearings is reduced to a minimum by the following ingenious arrangement: The floating power of the armature

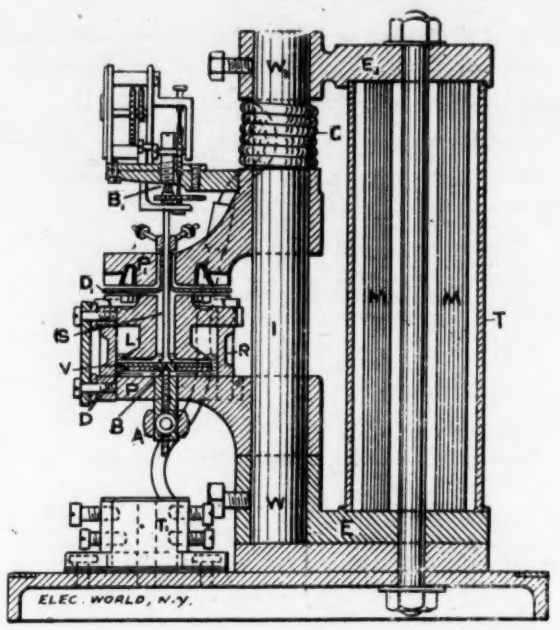


FIG. 10.

is so adjusted that at small current it is just able to support the weight of the spindle and discs. There is then a very light pressure on the upper bearing, which is very delicate and almost frictionless. As the current increases, however, the centrifugal force of the mercury draws the armature down on to the much stronger and more durable bearing at the lower end. By this means the delicate upper bearing is used only at small currents, when friction has a comparatively large effect. The flotation of the lower disc is adjusted by attaching to it a disc of vulcanized fibre.

A correction is made for fluid friction by slightly increasing the armature field at higher speeds, without altering the brake field. This is effected by attaching to the iron piece L a flat iron bar (not shown in the drawing) which bends downward by the side of the lower pole piece. This forms a magnetic shunt circuit energized by a few series turns. When the current is very small it weakens the armature field by shunting some of it, but as the current increases a reversal takes place, the armature field being strengthened by the shunt induction. Besides this there are a few series windings placed on the upper polar extension of the permanent magnets, and having such a direction as to strengthen the magnets.

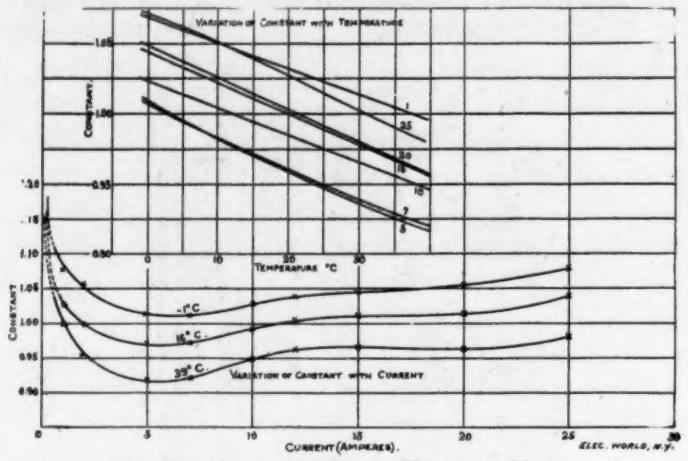
TABLE V.—CHAMBERLAIN AND HOOKHAM METER.

Maximum current 25 amperes. $a = 624$. $K^1 = 1$.

Current A.	At −1°C.		At 16°C.		At 39°C.	
	w	K	w	K	w	K
1	0.1608	1.076	0 1678	1.032	0.1768	1.00
2	0.3281	1.057	0.3478	0.998	0 3640	0.953
5	0.856	1.011	0.897	0.966	0.945	0.918
7	1.200	1.010	1.250	0.971	1.316	0.922
10	1.688	1.026	1.750	0.991	1.830	0.947
12	2.102	1.038	2.073	1.003	2.168	0.960
15	2 480	1.046	2.578	1.010	2.700	0.963
20	3.290	1.052	2.435	1.011	3.615	0.960
25	4.080	1.075	4.176	1.037	4.430	0.978

TABLE VI.

Meter.	Max. current in amperes.	Normal pressure in volts.	Resistance in ohms. Main circuit. At 1 ampere.	Resistance in ohms. Main circuit. At max. current.	Resistance in ohms. Shunt circuit.	Power wasted at max. current. Main circuit.	Power wasted at max. current. Shunt circuit.	Power wasted at max. current. Total watts.	Fall of potential in series circuit at max. current.	Starting current per cent. of max.	Temperature coefficient.
Elihu Thomson	10	100	0.0948	0.0958	3101	9.58	3.22	12.8	0.958	1.4	—0.32
Schuckert	15	110	0.0420	0.0438	2535	9.9	4.77	14.67	0.66	1.93	—0.13
Ferranti	25	..	0.0154	0.0131	..	8.19	..	8.19	0.327	0.8	+0.07
Perry	20	..	0.00327	0.00331	..	1.32	..	1.32	0.066	1.25	—0.47
Chamberlain & Hookham	25	..	0.0137	0.0157	..	9.8	..	9.8	0.392	0.8	—0.22



Curve V.—Chamberlain and Hookham Meter.

The current enters at the rim of the armature disc, passing radially to its centre, and is then led round the two series windings already mentioned.

The results of the tests on this meter are given in Table V., and shown graphically on Curve V. Referring to this it will be seen that the constant rapidly decreases as the current is increased, the curve crossing the declared value at about 8 per cent. of the maximum current and having a rather low value till at about 45 per cent. it crosses the declared value again, after which it remains fairly level until within 20 per cent. of the maximum current, when it bends upward. Solid friction, which, of course, is not compensated for in this meter, must account for the high value of the constant at low currents, and partly uncompensated fluid friction for the final rise. Perhaps also the low value at about 20 per cent. of maximum current may be due to the compensating effect being too great, as it probably would be at low speeds.

The curves showing the effect of temperature are also given on Curve V. The constant appears to vary in a very uniform manner, inversely as the change of temperature, the maximum effect differing very little from the mean. The mean temperature coefficient is —0.22 per cent. per °C. It is probably due to the combined effect of the increase of the electric resistance of the brake disc and decreased fluid friction, both of which would tend to decrease the constant as the temperature rises.

The starting current of this meter was found to be 0.2 ampere, or 0.8 per cent. of the maximum current. Its resistance is also very low and its general construction good.

GENERAL COMPARISON.

A very fair idea of the relative advantages and disadvantages of each meter may be obtained from Table VI.

The first two columns simply show the current, and in the case of energy meters the pressure for which each meter is intended. The resistance of the main circuit given in the next two columns was measured by means of a standard ammeter and a standard reflecting voltmeter, and the resistance of the shunt circuits on a Wheatstone bridge.

Considering first the Elihu Thomson meter, it will be noticed that its resistance is comparatively large, the fall of potential at 10 amperes amounting to nearly 0.96 volt. The temperature coefficient is also comparatively large, and the starting current 1.4 per cent. of the maximum current, which is, perhaps, not excessive for this class of meter, especially when used on alternate-current circuits.

The Schuckert has an advantage over the Thomson meter in that its resistance is very much less, reducing the fall of pressure and wasted power, but, on the other hand, its starting current is higher, being 1.93 per cent. of the maximum. Its temperature coefficient is also much less than that of the Thomson meter.

Turning now to the ampere-hour meters, the first point to be noticed is that their resistances are very much lower than is the case with the energy meters. Not only do they save the three or four watts absorbed in the pressure circuit, but the watts wasted in the main circuit appear to be much less.

The Ferranti meter starts with a very small current, 0.8 per cent. of the maximum, and has an extremely low temperature coefficient.

The Chamberlain and Hookham meter has an equally low starting current and a moderate temperature coefficient, its resistance being rather higher than that of the Ferranti for the same maximum current.

The Perry meter has an extremely small resistance, causing a fall of pressure of less than a tenth of a volt at maximum current and absorbing only 1.32 watts. In this respect it is far in advance of all the others, but it has the disadvantages of comparatively high starting current and temperature coefficient.

CONCLUSION.

In conclusion, the author must acknowledge his indebtedness to the following gentlemen, who have lent their assistance in various ways: To Professor Ayrton, for having afforded facilities for carrying out the experimental tests, and for his liberal assistance in supervising the paper. To Mr. Carter and Mr. W. M. Nelson, students at the Central Technical College, the former for his assistance in the laboratory, and the latter for having rewritten and arranged the results in their present form. And, lastly, to the manufacturers of the various meters for placing specimens at his disposal.

Alternating Current Machinery.—XVII.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

MUTUAL INDUCTANCE.

149. If two conducting loops, $A\ B\ C$ and $a\ b\ c$, Fig. 97, are fixed in space, and one of them, say $A\ B\ C$, is traversed by a steady current i, under the influence of an E. M. F. as shown at B, a certain quantity of magnetic flux will, we know, emerge from and be linked with A. In Fig. 97 this flux is diagrammatically represented by two dotted rings marked Φ and φ, respectively, so that the total quantity of flux linked with $A\ B\ C$, or the linkage of A, is $\Phi + \varphi$ webers, of which Φ

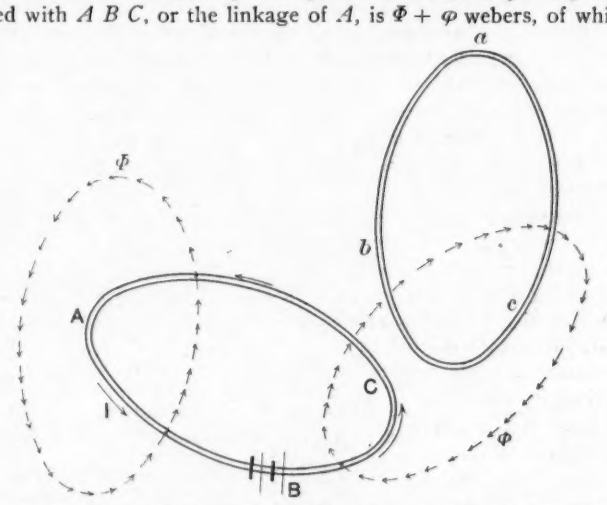


Fig. 97.—Diagram Representing Mutual and Self Inductance of Conducting Loops.

is linked with $A\ B\ C$ only, while φ is linked with both loops. The ratio of total linkage to current strength or $\frac{\Phi + \varphi}{i}$ is, as we have already seen (¶ 77), the self-inductance of the loop $A\ B\ C$. If $\Phi + \varphi$ is expressed in webers, or C. G. S. units of flux, and i in C. G. S. units of current, their ratio will be the inductance of the loop in centimetres, or C. G. S. units of length, while if $\Phi + \varphi$ is expressed

in webers and i in amperes we must divide the ratio by 100,000,000 to obtain the inductance in terms of the earth quadrant or henry, the practical electromagnetic unit of inductance and length (¶ 78).

In the same manner the ratio of the mutual flux φ linked with the loop $a\,b\,c$ in the positive direction, to the current strength, will give the ***mutual inductance*** of the two loops, or φ/i. As before, if φ is expressed in webers and i in C. G. S. units of 10 amperes each, the ratio will be the inductance in centimetres; while if φ is expressed in webers, and i in amperes, the ratio must be divided by 100,000,000 to give the inductance in henrys. Thus, if the flux Φ in Fig. 97 be supposed to be a megaweber, and φ 100,000 webers, while the current strength is maintained at one ampere, then the total linkage of $A\,B\,C$ will be 1.1 megaweber, and the inductance of the loop will be $\frac{1{,}100{,}000}{100{,}000{,}000} = 0.011$ henry, or 11 millihenrys, while the mutual inductance will be $\frac{100{,}000}{100{,}000{,}000} = 0.001$ henry $= 1$ millihenry.

150. It may be shown that so long as the two loops remain fixed in space and remote from iron or other magnetic metal the mutual

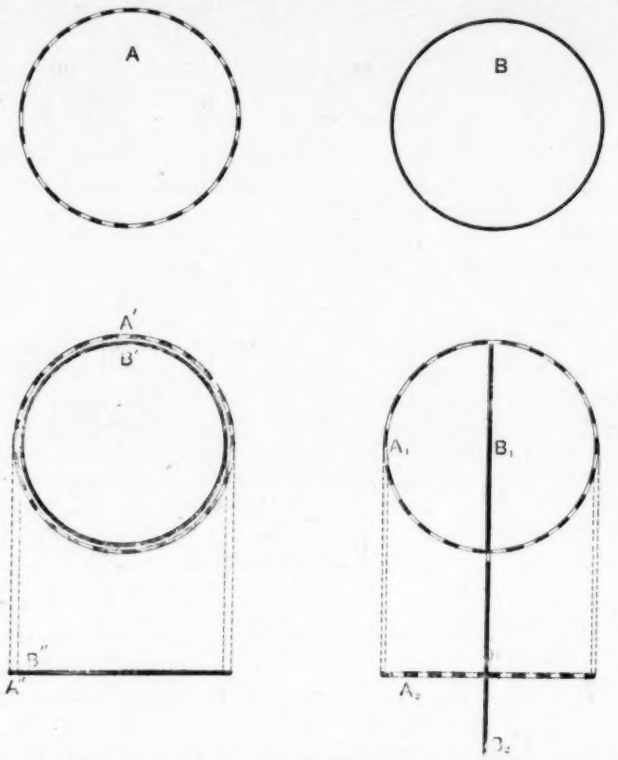


FIG. 98.—DIAGRAM REPRESENTING POSITIONS OF MAXIMUM AND MINIMUM INDUCTANCE OF RINGS A AND B.

inductance will be the same, whether we determine it in the above manner by exciting the loop A or the loop a. Thus, if 100,000 webers is linked with $a\,b\,c$, when one ampere flows around $A\,B\,C$, then 100,000 webers will be found linked with $A\,B\,C$ when the current of one ampere is removed to the ring $a\,b\,c$. The mutual inductance of two loops in space is, therefore, a conjugate, mutually determined, or reciprocal quantity, and this is true of any two coils or arrangements of circuits fixed in space and remote from iron, when their distance is large compared with the diameter of the conductor.

151. It is evident that for a rigid loop or coil the self-inductance is constant in space remote from iron, and does not depend upon the position or orientation of the loop. Thus, if the loop of Fig. 97 has a linkage of 1.1 megaweber with one ampere of current, this linkage will remain unchanged, whether the loop be inverted, or turned in one direction or another, provided that the loop is rigid and does not alter its dimensions. It may even be linked with exterior flux so that its total linkage may increase to, say, 1.5 megaweber, but if the linkage with and due to its own current remains only 1.1 megaweber, its self-inductance remains constantly at 11 millihenrys. The additional flux will induce E. M. Fs. in the loop on the entering or leaving, but these will be independent of the current strength around the loop, and only the flux associated with the current and supported by it enters into a consideration of self-induction.

It is equally evident that, on the other hand, any change in the relative positions of the two loops will in general produce a variation in the mutual induction. For example, if A and B, Fig. 91, represent two metallic rings of nearly the same diameter, the ring A being slightly larger in diameter, then if these two rings are placed in the same vertical plane as represented in Fig. 98, at $4'\,B'$ in elevation, or $A''\,B''$ in plane, the mutual inductance of the two rings will be a maximum, because if one ring carries a current, nearly all the flux with that current will also be linked with the other ring. On the other hand, if the rings be set perpendicularly to each other, as represented in elevation at $A_1\,B_1$, or in plane at $A_2\,B_2$, their mutual inductance will be zero, because their linkages will be completely in-

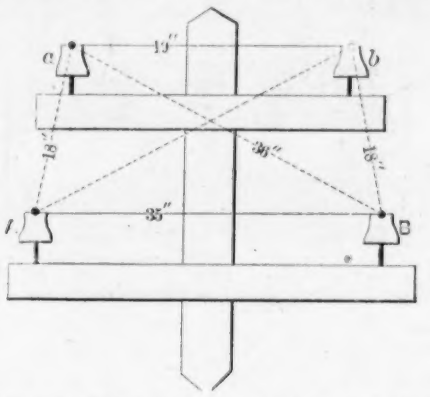


FIG. 99.—DIAGRAM REPRESENTING TWO PARALLEL AERIAL CIRCUITS.

dependent, and the current in one ring will send no flux through the other.

152. As an additional illustration we may consider the case represented in Fig. 99, of two pairs of aerial conductors, say, No. 6, A. W. G. copper wire forming a pair of circuits $A\,B$, $a\,b$, respectively. The distances between $A\,b$ and $a\,B$ are indicated as 36″, while $A\,a$ and $B\,b$ are 18″. By the table of inductances accompanying ¶ 82 the mutual inductance of the two circuits is readily found. Thus, considering the wire A separately, its distance from the other circuit wires are 36″ and 18″ respectively. In the table for No. 6 wire the inductances corresponding to these distances are 2.043 and 1.820 millihenrys per mile, respectively. The difference between these quantities is 0.223 millihenry. Similarly, considering the wire B separately, its distances from the wires of the other circuit are also 36″ and 18″, corresponding

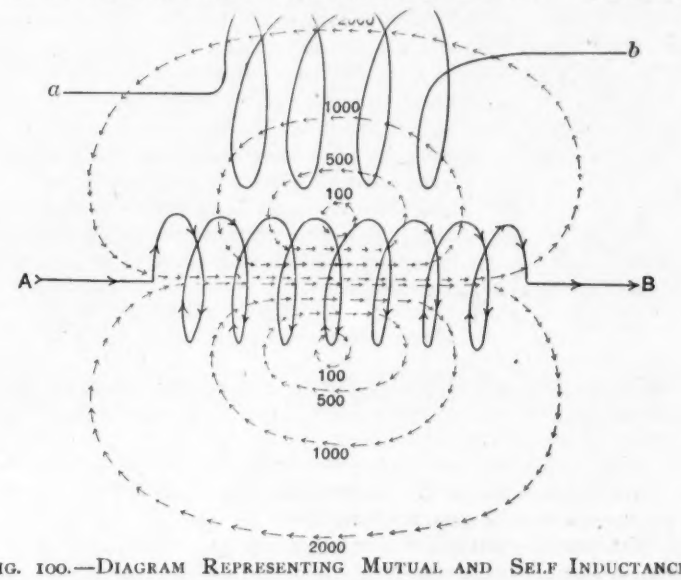


FIG. 100.—DIAGRAM REPRESENTING MUTUAL AND SELF INDUCTANCE OF COILS.

to inductances by the table of 2.043 and 1.820 millihenrys, the difference between these being again 0.223 millihenry.

The mutual inductance between the two circuits being

For the A wire	0.223 millihenry per mile
For the B wire	0.223 millihenry per mile
The total inductance between the two circuits $A\,B$ and $a\,b$ is	0.446 " " "

The self-inductance of the $A\,B$ loop, which is approximately 35″ wide is, approximately, 2 x 2.03 millihenrys per mile, or 4.06 millihenrys per mile, while the inductance for the loop $a\,b$, which is approximately 19″ wide, is approximately 2 x 1.83 millihenrys, or 3.66 millihenrys per mile.

If now we transpose the wires A and B at uniform intervals, so that these wires change places, keeping the loop undisturbed, the self-inductance of the two loops per mile is practically unaltered, but their mutual inductance is practically reduced to zero, because half of the flux emanating from one loop will pass through the other loop in the opposite direction to that of the remainder.

153. The same considerations may be extended from a pair of simple loops to a pair of coils containing an assemblage of loops. Thus, Fig. 100 represents the coil already considered in ¶ 79, at Fig. 52. This coil $A\,B$ is now represented as associated inductively with the coil $a\,b$, of four turns. If the current in the coil $A\,B$ is steadily main-

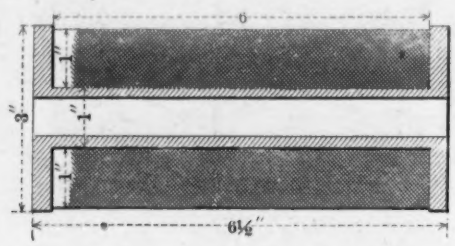


Fig. 101.—Section of Induction Coil.

tained at 2 amperes, and we count the flux linkages in the loops $a\,b$, commencing at the end a, we find

In the first loop	2,000 + 1,000 = 3,000	webers
In the second loop	2,000 + 1,000 + 500 = 3,500	"
In the third loop	2,000 + 1,000 + 500 = 3,500	"
And in the fourth loop near b..	2,000 + 1,000 = 3,000	"
Total mutual linkage between the coils	13,000	

Or, total linkage in $a\,b$ per ampere in $A\,B$ $\frac{13,000}{2} = 6500$ weber-turns; and this divided by 100,000,000 = 0.065 millihenry The self-inductance of the coil $A\,B$, as represented in the figure, is 0.412 millihenry (¶ 79).

It is evident that as we separate the coils $A\,B$ and $a\,b$ we rapidly diminish their mutual inductance, leaving their self-inductances practically unchanged.

By winding the two insulated wires $A\,B$ and $a\,b$, together, *i. e.*, side by side as a double wire on the same coil, the self-inductance of each will be less than it would be if the coils were single wound, owing to the relative separation of the wire in each winding from its own parts. But the mutual inductance of the two coils will now be practically the same as the self-inductance of either. Thus a wooden spool of the dimensions shown in Fig. 101, wound with two No. 22 A. W. G. wires of diameter 0.025" silk covered to 0.030", each wire making 3000 turns, gives two circuits, each of which has a self-inductance of approximately 80 millihenrys, while the mutual inductance is also approximately 80 millihenrys. If wound with the same amount of single wire, in the usual manner, the self-inductance of the coil so formed is approximately 0.32 henry.

No More Room Overhead.

The British Post Office is laying an underground telegraph cable between London and Birmingham. One of the chief reasons for adopting the underground construction is the difficulty in finding overhead routes. So many wires are strung between the chief cities in Great Britain that all the available routes have been used, and most of them are already loaded with as many wires as can be conveniently operated over them without serious interference. Room should be left overhead for additions to the present long-distance telephone trunk lines, hence in future new telegraph wires will probably be put below the surface. The new London-Birmingham cable contains seventy-six conductors, each conductor weighing 150 pounds per mile. The insulation is paper, and the cable is contained in a lead sheath.

Lord Kelvin's Tour.

Lord Kelvin has returned to New York City from his tour of the West, which he has made since the meeting of the British Association for the Advancement of Science. From Toronto his party traveled West over the Canadian Pacific to Vancouver and return. Lord Kelvin has been visiting relatives in Southampton, L. I. From there he will make a tour in Eastern Canada before returning to England.

Telephones in the Government Departments.

The Post Office Department is preparing to install a telephone service that will bring it in line with that contemplated by the Treasury Department and the Government Printing Office. Some time ago it was found that the ordinary telephone exchange system was not perfectly adapted to the varied needs of the executive departments, and a plan was devised by which a better service could be supplied. Branch exchanges were installed and equipped with the latest type of common-battery switchboard, metallic circuit wiring and long-distance equipment. The first example of this service in its perfect form was installed in the National Museum about two years ago. The next attempt to make use of such a system was the establishment of a branch exchange service for the United States Senate. For this the latest type of instruments and the highest grade of wiring were used, while the exterior of the common-battery switchboard was specially designed by an expert draughtsman of Tiffany & Co., and constructed by the Western Electric Company, with all the latest improvements, the woodwork being of mahogany, and in quality and finish precisely similar to that used in the new Library Building. A third similar change has now been installed in the United States Post Office Building. A fourth branch exchange has been arranged for with the United States Treasury, and a fifth with the Government Printing Office, which will undoubtedly be followed by three or four others before the assembling of Congress.

The value of this service is in the range of its capabilities, whether used for intercommunication, such as communications from room to room in a department building, for local exchange service, or for long-distance service. When all the departments are equipped as proposed, it will afford communication by means of interdepartmental trunk lines, between any two or more departments of the Government, the two houses of Congress, the Government Printing Office, National Museum, Executive Mansion, etc., besides having trunk line communication between the main switchboard in the Washington Exchange and the different branch exchanges in the departments. It will undoubtedly largely replace the telegraph service hitherto depended upon for interdepartmental communication, inasmuch as it will not be necessary to depend upon a skilled operator, as it can be used by any officer of the Government.

The new system requires no battery at a subscriber's station, a universal battery being placed at the switchboard. When a call is made from one of the stations no bell is rung, as the removal of the telephone from the hook indicates to the operator at the switchboard that a conversation is desired, and when through, the replacing of the receiver on the hook indicates to the switchboard operator that the conversation is closed. This dispenses with a great amount of noise from the ringing of bells, and is also a saving of time and labor.

Mr. Perry Heath, First Assistant Postmaster General, the prime mover in the installation of this service in the Post Office Department, speaks of it as follows:

"I found in the department here upon my entry into the service a little telephone system that established a sort of communication between four or five divisions, installed at the expense of the department. There was just enough efficiency in the service to give other officials in the department a foretaste of what might be expected of a system that was perfect in its execution. This little interior service simply communicated with four or five chiefs of divisions by direct wires from my desk. The system we have now installed has its ramifications throughout the United States. It is, in its local character, extended to every branch of this department, not only in this building, but in the outside buildings connected with the department. It is then connected with the Washington City system, and it is as easy to talk to anyone in the city as it is to speak to your next door neighbor in the department. We are frequently called on the long-distance telephone from post offices in all parts of the country, and it is a great convenience to be able to simply lift up your receiver from the switch on your desk and talk to the Postmaster at Chicago or New York or any distant point without moving in your chair.

"I was very much pleased with the facility with which the telephone system was installed. Within a few days I had diagrams and estimates presented to me by Mr. Crandall, the electrician of the company, and within two weeks the service was in full operation. It is constructed, too, upon the most substantial basis, and could not well be disturbed by any accidents, such as lightning or storm or fire."

The Influence of Accurate Measurements Upon Economic Operation.*

BY CARYL D. HASKINS.

In no branch of commerce, save, perhaps, in some of the industries dependent upon the generation of electrical energy, is it considered sufficient to know only what raw material is used, and what revenue is received. Nor is this information actually regarded as sufficient, even in these industries.

Until very recently, however, there has been no satisfactory method of actually determining how much electrical energy has been produced during any given period.

Many generating stations in the early days followed a system of frequent readings of ammeters and voltmeters, basing their assumptions as to the actual output on the product of coincident readings, multiplied, of course, by the time factor, thus obtaining an approximation of the kilowatt hours output per day, and therefore the approximate cost of generation per kilowatt hour.

Many, however, abandoned these frequent readings of instruments, feeling that the approximations of true output measurement were too unreliable to be of real value, because of the constant fluctuation of load between readings.

The conditions just described are in reality those of yesterday rather than to-day, and they existed only up to that time when it became possible to obtain output meters of sufficient capacity to measure in an accurate and proper manner the true output.

Such meters as those to which I refer are now readily obtainable, and are being rapidly adopted, not only by street-railway companies, but by lighting companies also.

Electrical engineering skill has responded to the needs of the industries to which it is tributary, and standard designs now exist up to capacities as high as 8000 amperes, while special instruments have been designed large enough for 16,000 amperes.

These total outputs meters are accurate to a high degree, not only upon steady and normal loads, but upon rapidly fluctuating loads as well, giving a true account of all energy output through them on loads ranging from 5 to 6 per cent. of their rated capacity up to about 15 per cent. above their rated capacity, the reliability of the record being unaffected with the rapidity of fluctuation of current between these points.

It is doubtless needless for me to emphasize the real economic value of the reliable data which can be obtained by the use of these total output meters.

Knowing the efficiency which is to be expected from the generator, engine and boiler equipments, it is a simple matter to determine just how much coal and water should have been expended for the run of any given day to generate the indicated kilowatt hours output.

Thus it not only becomes possible to determine just what it is costing to generate a kilowatt hour, but it also becomes possible to check the inefficiency of the equipment, and to locate trivial faults which might otherwise have escaped notice.

For example, should the indicated output fall 10 per cent. below what ought reasonably to be expected from the known input of coal and water, an effort would at once be made to determine where the trouble lay, whether in uneven firing of the boilers, ill-set valves on the engine, or some minor fault in the generator.

In no other way known to me can this positive means of check upon a generating system be maintained than by the use of total output meters.

Important as is the measurement of the total station output, there is yet another application of positive measurement which, while it has been long appreciated by many, has not been applied in practice at all up to the present time, simply because the necessary meter was not available. I refer to the measurement of the energy used daily to operate each car.

Every street railway management realized that a quite large proportion of the total energy generated is wasted by the careless and improper use of the controller and the brake, and where the old rheostat method of control is used the opportunity for waste on the part of the motorman is yet greater.

Almost every street railway superintendent makes a different estimate of the percentage of power wasted upon the system under his charge for there can be no positive knowledge upon the subject, nor can the conditions be regarded as at all stable. An average drawn from the opinions which have been expressed to me would, however, indicate that not less than 20 per cent. of the total energy generated is wasted by improper manipulation of the handles upon the part of the motorman, this improper manipulation being due to some extent to ignorance, but more generally to carelessness.

A meter has now been designed which will, I believe, change all of these wasteful conditions. This meter is intended for permanent installation upon the car, and its indications show accurately the consumption of energy in kilowatt hours for any desired time.

Grave difficulties surrounded the designing of a satisfactory meter for this purpose, and the perfecting of the device has only been accomplished by sustained effort extending over a long period. It was necessary not only that the meter should be accurate under the extremely unfavorable conditions of heavy vibration and shock to which it has to be exposed, but also that its construction should be of such a character as to endure these rough conditions for long periods without damage to the mechanism and without the impairment of accuracy.

Such a meter as that which I have described is now obtainable, and has been successfully operated in actual service over an extremely rough piece of track for many months.

With a street-car meter permanently installed on every car, the street-railway management at once has the same means of checking the motorman as is provided by the cash register for checking the conductor.

Assuming that the energy is actually 20 per cent. of the total, as I believe it to be, it is, I think, fair to expect a saving of about half the present waste, or 10 per cent. of the whole amount of energy generated, as a result of the knowledge on the part of the motorman that the management has absolute means of ascertaining how much power he uses per run, or per passenger, or per mile. For under this system he cannot fail to realize that the management has in its possession adequate and reliable data upon which to base promotions or encouragement, reprimand, or discharge.

Many steam railroads have long made a practice of offering annual prizes to the engine crew doing the most work with the least coal and water, and I anticipate that a similar system of reward may be found advantageous and profitable in street-railway practice.

Cutting down the waste of energy 50 per cent. means saving 10 per cent. of the total output, and it therefore means to the street-railway management either the saving of 10 per cent. of the coal and water which are being used to-day, or the ability to operate 10 per cent. more cars with the same central-station capacity. In whichever way the matter may be viewed—whether in the light of a saving of raw material, or an increase in service without increase in expense at the station—the economy accomplished is very great, and I venture to assert that the influence of accurate measurement upon economic operation is of the first importance, provided proper use is made of the data thus obtained.

* Abstract of a paper read at the Niagara Falls meeting of the New York State Street Railway Association, September 14 and 15, 1897.

The Convention of the Association of Edison Illuminating Companies.

In the last issue of THE ELECTRICAL WORLD was given a report of the first two days' proceedings of the convention of the Association of Edison Illuminating Companies, which was held at Niagara Falls, N. Y., on September 14, 15, and 16.

At Thursday's session Mr. Chas. E. Pattison presented a paper entitled "Storage Battery Progress and Results in the Edison Boston Stations." The paper embodied a record of three years and six months' experience with the first battery, two years and three months with the second, and one year with the third. His conclusions were that his company's experience to date indicated great benefits from the batteries, and that while they had weaknesses, the expense of maintenance was not so great as for some of the other apparatus in use. The most notable benefits were the better regulation of pressure on the system, particularly the elimination of fluctuation, due to intermittent motor loads, such as direct-connected elevators; the improvement of generating economy, due to the custom of charging the batteries during hours when the load would otherwise be light, and the reduction of expense, hitherto necessary in keeping furnaces banked and engines ready for emergency use.

The discussion by Mr. R. R. Bowker, Mr. W. S. Barstow, Mr. J. W. Lieb, Jr., Mr. L. A. Ferguson, Mr. Samuel Scovil, and others, showed differences of opinion among the members having experience with batteries as to which of the advantages to be gained by their use was of primary importance. The expressions varied between those given by Mr. Pattison and that by another delegate, who was of opinion that the immediate availability of the battery, as a reserve in case of accident to the generating plant, was its principal recommendation.

Mr. J. W. Lieb, Jr., presented the report of the Committee on Storage Batteries, which, among other matters, contained a recommendation that a rating of battery capacity, more conservative than that heretofore in use by the manufacturer, should be adopted.

The report of the Executive Committee and the report of the Lamp Testing Bureau, presented by Mr. Wilson S. Howell, the chief of the testing bureau, were read and fully discussed, and, after electing officers and Executive Committee for the ensuing year, the convention adjourned.

The following is the list of officers elected: President, Samuel Insull, Chicago; vice-president, R. R. Bowker, New York; treasurer, W. S. Barstow, Brooklyn; secretary, Wilson S. Howell; Executive Committee, Chas. L. Edgar, Boston; Alex. Dow, Detroit; Geo. R. Stetson, New Bedford; J. W. Lieb, Jr., New York; Samuel Scovil, Cleveland.

The Calculation of Transformer Efficiency.

To the Editor of the Electrical World:

Sir—In his article on the design of a 1250-watt transformer in your issue of September 18, Professor Carhart demonstrates by the ordinary method of the calculus that the efficiency of a transformer is highest (under certain conditions) when the iron loss equals the copper loss. The bracketed words are mine.

The mathematical process used by Professor Carhart is correct in itself, and the same may be said of his result, when an obvious typographical error is corrected, nevertheless he carries his inference therefrom too far. The required correction is this: $\frac{dc}{dI}$ should be substituted for the $\frac{dI}{dc}$ of the text.

The supposition on which the minimum occurs is that I, the secondary current, is the independent variable, and that c, the ratio of the total watts lost to the total watts in the secondary (assuming secondary current and E. M. F. to be in phase), is the dependent variable or function. That is $\frac{dc}{dI}$ is put equal to zero. It must be borne in mind that by this hypothesis the other quantities written in the equation, namely a, b, E and R, are constants.

The only question which is really answered by the algebraic result obtained is this: With a given transformer (working, of course, on a primary current of constant frequency, and with constant iron loss and constant copper resistance), what value of the secondary current (and consequently of the copper loss) gives the highest efficiency? But Professor Carhart goes further and assumes that the condition of minimum is the same when other quantities vary, as, for example, the resistance, and even claims to have found the relation between iron loss and copper loss for highest efficiency at any load. It is obvious on a moment's thought, without going into calculus at all, that, other things being equal, the lower the resistance of the copper the higher the efficiency, so that Professor Carhart's result does not apply to the determination of the proper amount of copper in designing a transformer. If we wish, however, to prove by calculus a proposition that is already evident we differentiate Professor Carhart's expression for c, on the assumption that R is the independent variable and c the function. We find that $\frac{dR}{dc}$ is a constant and cannot be put equal to zero, and that there is therefore no minimum of c, or maximum efficiency.

In making this criticism I am running the risk of being classified by Professor Carhart among those practicians who "indulge in a little top-lofty patronage of those who, they admit, are doubtless very scholarly," but Professor Carhart need not take this criticism all to himself, as this same very useful operation in calculus has, I think, suffered more abuse than any other rule in applied mathematics, among practicians, as well as college professors and others. Those of us who can remember what has happened in the past fifteen years or so, will recall many fallacies, all based on the rule for maxima and minima, and every one supported by some eminent practician, college professor, or theoretician, some by several eminent names, and some defended by the electrical press. The first was the rule that the external resistance of a (series) dynamo circuit should be equal to the internal resistance of the dynamo, for maximum efficiency. This is really a case of maximum; the maximum expenditure of energy in the external circuit, but is absolutely ruinous as regards efficiency. I believe that this rule was first promulgated by a theoretician, but am not sure. Then came an oracular delivery from a prominent European engineering firm to the effect that the resistances of the field (series) and armature should be equal for maximum efficiency. These were both before the days of commercial shunt machines, but after the shunt field came into use the second fallacy cropped up again in another form thus: the ampere turns on any machine, generator or motor, should be equally divided between the armature and field for maximum weight output. This rule appeared in connection with the name of an eminent engineer and inventor, but had been previously discovered and abandoned by at least one other engineer. These are not all the fallacies that have grown out of the abuse of this rule, but space is limited.

Townsend Wolcott.

The Permanence of the Edison System of Distribution.

According to a statement made by President Samuel Insull, in his address before the convention of the Association of Edison Illuminating Companies, which was held at Niagara Falls, N. Y., last week, the Edison system of distribution stands unique among new industries in respect to its permanence. "Our main investment, in the larger cities, at least," he said, "is in our underground work, and if you will look over the records of the various companies using the Edison system, I think you will find that their underground work is as useful to them now as when it was laid, and it seems to me that there is no reason for us to fear that this condition will change in the future. We may have different methods of illumination," said Mr. Insull, in conclusion: "we may get a higher voltage lamp; we may find that the current of the future will not require as large a cross section of copper as in the past, but I doubt if we will find that any method of distribution will be invented that will supplant that which we are using."

An Object Lesson.

Some of the uncertainties of operating a municipal electric light plant were revealed at a recent meeting of the City Council of Port Angeles, Wash. Mr. Klaunig, the lessee of the city electric light plant, had become in arrears in his rent. The city clerk had dunned him for the money, and Mr. Klaunig made, before the council, a personal explanation of his delinquency substantially as follows: He said it was impossible to pay any more rent; the expenses of the plant for the past month were $111, and the receipts but $117.50, leaving him $6.50 for his month's work. Wood and labor were increasing in price, and the receipts were getting smaller. It took two cords of wood per night to operate the plant, and it was eating up all the profits. He had spent $250 on the plant, and would spend no more: the council could do what it pleased. He had no objections, and was ready to turn over the plant on a day's notice.

Electric Railway at the Paris Exposition.

The *Journal Officiel* has published notice of an open competition, by order of the Minister of Commerce, Industry and the Postal and Telegraph Departments, for the concession of an electric railway for the conveyance of visitors into the precincts of the exposition buildings, on the left bank of the Seine. Persons who wish to obtain the concession must make known their intention before September 30, by writing to the officers of the exposition, at Paris.

Still Favor Gas.

The maidens now are kicking at the incandescent lights,
Because they spoil the sweetness of the weekly sparking nights—
They say they are a nuisance and "had really ought to go,
Because, you see, they can't be turned away down low."

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamos. MORDEY. *Jour. Inst. Elec. Eng.*, July.—A reprint of the complete paper and discussion which was noticed in the *Digest*, June 12 and 19.

Right and Left Handed Armature Windings. HAWKINS. Lond. *Elec.*, Sept. 10.—An illustrated article in which he gives a rather thorough discussion of the direction of winding of the various forms, including also the direction as determined by the method of connecting the coils; he also gives certain rules for tracing the direction of the winding.

Commutator Bar Sections.—Lond. *Elec. Rev.*, Sept. 10.—A communication from the Forest City Electric Company, Cleveland, Ohio, with a copy of its table for the divisions of commutators which it uses; it is intended for calculating and ordering commutator bars of various sections.

Construction of Armature Cores. BAXTER. *Amer. Mach.*, Sept. 16.—An illustrated article of a practical nature on the construction of jigs for drilling holes in the end rings of armature cores.

LIGHTS AND LIGHTING.

Alternating Arc Lamps. CLAUDE. *Bul. Soc. Int. des Elec.*, June.—A reprint in full of the paper which was noticed in the *Digest*, July 3, 24 and August 21.

Lighting of Railway Cars. GORDES. *Prog. Age*, Sept. 15.—The beginning of a translation of a paper which is, no doubt, the same one referred to in the *Digest*, last week; he compares the Pintsch gas system with the electric light, to the advantage of the former (the author is one of the chief engineers of a company which instals the Pintsch gas system).

POWER.

Electrically Worked Gold Dredge.—Lond. *Elec.*, Sept. 10.—A brief description, with some particulars, of the dredge used on a claim in New Zealand; the energy is obtained by water power from a neighboring falls.

Power Station Load Lines. ABBOTT. *Cassier's Mag.*, Sept.—A short article describing what is meant by load lines and showing how they may be used for determining the economical output; a number of characteristic load lines are given; he claims that manufacturing without load lines is like banking without a bookkeeper; the thoughtful engineer will derive unerring information from these, as to the economical conditions.

TRACTION.

Present Tendencies of Electric Tramway Traction. ALDRIDGE. Lond. *Elec. Eng.* and *Elec. Rev.*, Sept. 10.—A reprint, with the illustrations, of the British Association paper which was abstracted in THE ELECTRICAL WORLD, Aug. 28.

The Generation of Electric Energy for Tramways.—Jour. Inst. Elec. Eng., July.—A reprint of the complete discussion of Raworth's paper noticed in the *Digest*, June 5.

Electric Tramways in Austria.—Zeit. fuer Elek., Sept. 1.—A table showing the operation of each of the nine lines.

Montreal Tramway System. CUNNINGHAM. Lond. *Elec.* and *Elec. Rev.*, Sept. 10.—A reprint of a British Association paper. A description of the electric railways under his direction, with special reference to the operation.

Dover.—Lond. *Elec. Eng.*, Sept. 10.—An illustrated description of the trolley system in Dover, a brief account of which was given in THE ELECTRICAL WORLD last week.

Montmorency. DIEUDONNE. *L'Eclairage Elec.*, Sept. 4.—A long illustrated description of the electric railway running from this city to d'Enghien.

Electric Carriages. HOSPITALIER. *Bul. Soc. Int. des Elec.*, June.—The completion of his recent paper, the present portion describing the evolution of these carriages from 1881 to 1897, and containing a large number of illustrations (see also *Digest*, July 24).

Canal Boat Traction—Cassier's Mag., Sept.—A short illustrated description of a system suggested by Schatz; in this the boats are drawn by a sort of locomotive running on rails and drawn by means of a rack along the towpath; it is either operated by a man on the locomotive or from the boat] itself by means of wires; the current is carried by double conductors along the track level on the opposite side of the rack.

Electrolier for Night Repairs on Trolley Lines. HOPKINS. *Elec. Eng.*, Sept. 16.—A brief, illustrated description of a handy arrangement consisting of a pole having five lamps in series under a reflector, the upper part of the pole being a hook for hooking over the trolley wire and forming one terminal, the other terminal being a wire from the bottom of the pole which is temporarily connected to the rail.

Power Required for Driving Vehicles.—Elec. Eng., Sept. 16.—A reprint of a table giving the traction force for various roads, loads and tires.

Air Ship.—Elec. Eng., Sept. 16.—A brief illustrated description of a proposed electrically driven ship with an ascensional power of 50 tons being constructed of a steel cylinder from which the air has been exhausted.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Tension Direct-Current System at Oxford.—Lond. *Elec. Eng.*, Sept. 10.—A reprint of the complete report by Kennedy, including diagrams of the 24-hour test of the working of this system, which is often referred to as the Oxford system, and has been noticed before in these columns. The figures are of service in estimating the value of this system, which up to the present time has been largely a matter of opinion. The great advantage of a high-tension direct-current system over the alternating current is that the transforming apparatus is worked only at times of full load and hence at high efficiency; at other times the accumulators in the sub-stations and central station are able to supply the whole of the load without requiring the full staff of attendants; the large annual loss due to hysteresis in the transformers is also avoided; the central station costs for the third year of this station have been reduced to 3.72 cents per kw-hour; at Wolverhampton, where the same system is used, the cost for the first year was only 3.66, which compares favorably with the figures of alternating-current stations.

Determining Synchronism by the Telephone. MEYER. *Zeit. fuer Elek.*, Aug. 15.—A brief description of a method for determining the synchronism and the equality of phase of two alternators to be connected in parallel; the advantage of the method is said to be the cheapness of the apparatus and the small amount of current used; it seems to consist simply in connecting the two leads with a resistance, part of which is shunted by the circuit containing the telephone; when there is synchronism and phase equality there will be no noise heard in the telephone.

Indicator for a Broken Wire.—Lond. *Elec. Eng.*, Sept. 10.—An illustrated description of an apparatus used by Schuckert & Co. for indicating a broken wire in a multiphase system. The three currents are made to pass through three solenoids placed underneath the corners of a horizontal suspended triangle, from the corners of which are hung the cores which pass into the solenoid; this triangle is so suspended over its centre of gravity, that when the pull is unequal at the three corners it will tilt and thereby give an alarm.

Central Station Statistics for Germany.—L'Eclairage Elec., Sept. 4.—An abstract of the statistics recently referred to.

Exhibition Plant.—Lond. *Elec. Rev.*, Sept. 10.—A well-illustrated description of the plant at the present Victorian Era Exhibition in London.

Economy and Distribution of Electrical Energy. FERGUSON. *West. Elec.*, Sept. 18 and *El'ty*, Sept. 15.—A reprint of a paper with this title read at the Association of Edison Illuminating Companies. He does not approve of having steam-generating systems distributed in various sections of large cities, but recommends a combination of the alternating and direct current, using the former for transmission and the latter for distribution; he prefers the three-wire direct-current system if the distance to the centre of distribution be less than a mile, but beyond that he advocates the use of sub-stations, the apparatus in all of which is the same. There are three systems for supplying such sub-stations; in the first the main station would contain three-phase alternating-current generators equal to the entire output of all the sub-stations; in each of the sub-stations there should be stationary transformers to reduce the pressure to 80 volts and then rotating transformers for generating direct-currents for distribution at 115 to 130 volts; this method is claimed to be an exceedingly efficient one. The second one, though not as efficient, is useful in

developing new territory; rotary transformers at the main station change the direct current into a three-phase alternating current which is then transformed by stationary transformers to a current of a high voltage for transmission; the apparatus at the sub-station would remain the same as in the first method. The third method combines the advantages of the first and second, and has none of the disadvantages; all the generators give a three-phase alternating current and a direct current at the same time, the former being sent to the sub-stations after being passed through step-up transformers and the latter being used at the main station. The brief discussion, which contained nothing important, is also given.

Municipal Ownership. Francisco. *Elec. Eng.*, Sept. 16.—An unfavorable criticism of a recent article by Winchester, who favored municipal ownership.

WIRES, WIRING AND CONDUITS.

Testing of Interior Wiring.—Lond. *Elec. Rev.*, Sept. 10.—An editorial comparison of the recent Institution rules referring to the testing of interior wiring, the comparison being made with other similar rules. The rule is that after all the lamps, appliances and fuses are connected, an E. M. F. equal to twice that which is to be ordinarily used is to be applied, and the insulation resistance between the whole system and the earth must be measured after one minute's electrification; this insulation should not be less than 10 megohms divided by the maximum number of amperes required for the lamps and appliances; a second similar test should be made after an interval of 15 days' running. This is compared with the Board of Trade rule, and it is found that different values for the same installation would be obtained; for different voltages for instance diverging values for the required insulation are obtained; in any case the insulation asked for is said to be low, but the Institution figure is from 5 to 10 times higher than what is required by the Board of Trade. It is thought editorially that Jamieson's rule covers all ordinary cases in the most satisfactory way, as the constant can be modified for motors or lamps; Jamieson's rule is that the resistance is equal to a constant, multiplied by the voltage and divided by the number of lamps; this is thought preferable to the use of the current, as the insulation in house work depends largely on the points and fittings, which vary with the number of lamps and not with the current; it is thought that the average figure in practice is about 16 megohms per lamp on a 100-volt supply. The fact that the test is to be taken with double the working pressure is thought to be a very good precaution; the other precautions are also approved.

Liquid Air and Electrical Conductors. Fleming. Lond. *Elec.*, Sept. 10.—A communication pointing out the impracticability of the suggestion which appears to have been running through the British press, to use liquid air for reducing the resistance of conductors for the distribution of electrical energy; assuming that the stupendous mechanical difficulties of using liquid air for this purpose have been overcome, he calculates what the value is of the energy lost in the mains and shows that if liquid air can be produced at five gallons for one cent, its use might not be chimerical; he does not give the present cost, but it is inferred that it is out of all proportion with this; he shows that it would require three or four hundred gallons of liquid air to begin with to cool the whole mass of a transformer weighing a ton to —185° C. and perhaps 50 or 100 gallons per day to supply the loss, all of which would be done only to save 18 cents a day; he believes it would be an exceedingly treacherous insulator for transformers; the suggestion, he states, flavors of Jules Verne.

Experimental Study of Fuses and Circuit Breakers. Laporte. *Bul. Soc. Int. des Elec.*, July.—A reprint of the complete paper, with diagrams, which was noticed in the *Digest*, Aug. 7.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Research at Low Temperatures. Lond. *Elec.*, Sept. 10.—A very long abstract, with 13 illustrations, mostly of the curves of results, of five Royal Society papers by Dewar and Fleming, on the dielectric constants of various substances at low temperatures. Editorially it is stated that their researches contain many points of interest and novelty and will repay careful study. At a temperature of 200° C. the dielectric constants of most aqueous solutions approach that of water, although at temperatures somewhat above this much larger values are obtained; they endeavor to correlate the electrical properties of such liquids with their chemical composition; they examined the conductivity of certain electrolytes at temperatures well below freezing point and found that certain aqueous solutions are almost perfect insulators, but that when their temperature rises the resistance falls suddenly and enormously, long before their melting point is reached; this would seem to be a case in which an electrolyte is not dissociated and yet conducts; if it can be shown that the conduction is electrolytic, then it is clear that dissociation of the molecules is not a necessary condition of electrolysis. Another noteworthy point in the researches is the clear demonstration that obedience to Maxwell's law (namely, that the electric constant equals the square of the refractive index) is conditioned by temperature.

Researches with the Platinum Resistance Pyrometer. Tory. Lond. *Elec. Eng.*, Sept. 10.—A reprint of a British Association paper giving an account of experiments with applying this pyrometer to studying the phenomena of thermo-electricity, the direct object being to obtain a more direct verification of Tait's parabolic formula. He obtained differences which are quite beyond the limits of possible experimental errors, and, therefore, Tait's formula simply means to draw the nearest parabola; there seems to be no reason, however, to conclude that the formula may not represent the physical explanation of the effect, at least to a first approximation.

Origin, Variations and Perturbations of Atmospheric Electricity. Brillouin. *Rev. Gén. des Sciences*, Aug. 30.—He gives a hypothesis based on ultra-violet radiations, and thinks this capable of giving a satisfactory explanation, on the supposition that ice behaves like metal, a fact which he convinced himself of during the past winter; metallic surfaces charged with negative electricity lose this on being exposed to ultra-violet radiations; ice is very sensitive to these radiations, while water is not.

Intermittent Currents of High Frequency. Rocher. *Proc. Lond. Phys. Soc*, Aug.; abstracted from the *Comptes Rendus*, p. 185.—The frequencies varied from 1200 to 7000 per minute; the currents were direct; they break up solid bodies, volatilize liquids and decompose gases, and they produce phenomena which cannot be reproduced at will; in one case a ball of fire resembling ball lightning was produced.

Polarization Capacities. Gordon. *Wied. Ann.*, 61, p. 1; abstracted briefly in the *Proc. Lond. Phys. Soc.*, Aug.—Presumably the same article as was noticed in the *Digest*, July 17. He shows that the capacities are the same for all frequencies.

Capacity of Conductors. Potier. *Proc. Lond. Phys. Soc.*, Aug.—Abstracted from the *Jour. de Physique*, 6, p. 238. He describes a graphical method of calculating capacities of a system of conductors.

Use of the Interferometer in the Study of Electric Waves. Hull. Lond. *Elec. Rev.*, Sept. 10.—The conclusions arrived at in his recent British Association paper, in which he used the Michelson form to analyze electric radiation.

Doublets and Triplets in Spectrum Produced by Magnetic Forces. Zeeman. *Phil. Mag.*, Sept.—A continuation of the paper noticed in the *Digest*, July 24.

Crookes Tubes. Villard. *Proc. Lond. Phys. Soc.*, Aug.—An abstract of a French Physical Society paper in which he shows tubes that can be regenerated and regulated while in action; the anti-cathode is of pure iridium, which does not form a deposit on the glass; an auxiliary cathode of aluminum or of magnesium serves to give out some gas when the vacuum becomes too high, and when too much gas has been given off this electrode is made the anode; another supplementary electrode used as the cathode, and in "more or less effective communication" with the cathode, and directed on the same point of the anti-cathode, serves to regulate the resistance of the tube.

Cathode and Röntgen Rays. Battelli. *Proc. Lond. Phys. Soc.*, Aug.; abstracted from the *Nuovo Cimento*, p. 386.—Thompson's conclusions that there are special rays in a Crookes tube which are neither cathode nor Röntgen rays are not necessary; the results may all be explained by the author's hypothesis that Röntgen and cathode rays are of the same nature, but that the former constitute only a part of the latter; experiments are described confirming this; there is no complete reflection of cathode rays.

Emissivity of Metals for Röntgen Rays. Kaufmann. *Proc. Lond. Phys. Soc.*, Aug.—A brief abstract of an article in which he gives the following order of the metals: Aluminum, iron, nickel, copper, tin, zinc, silver, cadmium, platinum, lead and uranium, platinum being about ten times as emissive as aluminum; the composition of the rays does not in any way depend on the nature of the emitting surface.

Change of Salts by Cathode Rays. Abegg. *Zeit. f. Elektrochemie*, Aug. 20.—Goldstein noticed that certain salts were changed by cathode rays; it was claimed by him that the change was physical, while others claimed that they were chemical; in the present short article he describes researches made to settle this question, and he concludes that they are physical and not chemical; also that the changes are not always the same as those produced by light.

Researches with Simple Cathode Rays. Deslandres. *L'Eclairage Elec.*, Sept. 4.—A reprint of an Academy paper describing researches with the cathode spectrum; among other things he shows that there is a certain resonance of the tube and in experimenting with X-rays such an excitation should be sought as will favor the resonance of that tube.

Action of X-Ray Tubes Behind Opaque Screens. Buguet. *L'Eclairage Elec.*, Sept. 4.—A reprint of an Academy paper describing a number of radiographs (not reproduced); he notices phenomena which are explained by the diffusion of X-rays in the air, paraffine, or other more or less transparent media.

X-Ray Photometer. Imbert and Bertin-Sans. Lond. *Elec.*, Sept. 10; noticed briefly from the *Comptes Rendus*, No. 2, July.—A description of a photometer consisting of a fluorescent screen, over which is laid a coarse grating of lead wires and a prism of aluminum (the principle is not new).

Rotating Magnetic Field. Colard. *L'Eclairage Elec.*, Sept. 4.—The beginning of an article of a mathematical character, in which he discusses the peculiar properties of a revolving field produced by an infinite number of currents differing by infinitely small phases; he shows that the interior field is truly a uniform field, and that the rotating movement of this field is also uniform; regarding the external field he finds that its intensity remains the same at every point, but varies from one point to another; also that the direction of the field at a point revolves with a uniform movement

around a point, but this movement is in the reverse direction to that of the interior field.

Magnetization in Two Dimensions. GRAU and HIECKE. *Proc. Lond. Phys. Soc.*, Aug.; noticed briefly from the *Ber. Berichte*, 105, p. 993.—They observed the various transverse and longitudinal magnetizations, giving the results in tables and curves; they also determined the hysteresis in rotating fields, and found that it diminishes at high induction densities.

Magnetic Properties and Electrical Resistances of Iron as Dependent Upon Temperature. MORRIS. *Phil. Mag.*, Sept.—A reprint in full, with a very large number of tables and diagrams, of the Physical Society paper noticed in the *Digest*, June 5.

Tortion and Magnetization of Nickel. CANTONE. *Proc. Lond. Phys. Soc.*, Aug.—The conclusions from a recent paper covering a very large ground.

Magnetization of Liquids and Their Dependence on Temperature. YAEGER and MEYER. *Wiener Berichte*, July.—The description of measurements, chiefly of solutions of magnetic salts in water.

Magnetic Properties of Recent Kinds of Iron. EBELING and SCHMIDT. *Jour. Inst. Elec. Eng.*, July.—An abstract, containing the tables, of the article which was noticed in the *Digest*, June 5.

Arc Spectra. FOLEY. *Elec. Eng.*, Sept. 16.—An abstract of an A. A. A. S. paper, describing extended photographic studies which were made of the spectra and of the arc, both vertical and horizontal, with the slit in different positions. The table of results (which is not reproduced) shows that the lines rapidly decrease in number as the slit is moved from the centre of the arc to the outer edges; in every case the carbon lines cling to the positive pole, and the metallic lines to the negative pole; this electrolytic nature of the arc was further confirmed by a series of measurements of the voltage between unlike electrodes; a higher voltage was required when the current flowed from carbon to a metal than when in the opposite direction. The order of the elements as regards the tendency of the spectral lines to cling to the negative pole seems to be the same as their order in the electropositive-negative series. The spectrum of the enclosed arc was also examined.

Prevention of X-Ray Burns. WOODS. *Elec. Rev.*, Sept. 15.—A long communication correcting some reports which have been running through the daily press. In order to prevent X-rays from producing burns he uses a screen made of gold leaf on cardboard and finds it very effective, the screen being grounded. In one case he found that quite a heavy spark could be drawn from the patient; when the gold was interposed and connected to earth the sparks entirely ceased. He warns those who handle powerful apparatus to take heed of the first sensation of heat spoken of by the patient; he gives some of his experiences and makes recommendations; he prefers using a lighting circuit to a battery, as it is more constant; he recommends treating such burns by a bath of high frequency currents from only one terminal of a high frequency coil; he believes that the burns are due to an electrical decomposition of the tissues; he concludes that X-rays are harmless when the above-mentioned precautions are taken.

Experiments on the X-Ray. PORTER. *Nature*, reprinted in the *Elec. Eng.*, Sept. 16.—He describes researches made to see whether the photographic effect of X-rays is influenced by passing the rays near a charged conductor; he therefore made numerous photographs of small plates of aluminum charged positively or negatively, or not at all, using a Wimshurst machine; the experiments seem to have been carefully made, and they show that the electrification of the discs were without effect, either absolute or comparative; the experiments were repeated under different circumstances, but no action was found that could be attributed to electrification; he therefore concludes that the radiograph of a conductor is not sensibly altered by even powerful electrification, nor are the rays altered in force or direction in passing through air in the neighborhood of a powerfully charged conductor, nor even through air which is being subjected to a powerful disruptive discharge; this he thinks makes it more difficult to believe that the rays are due to particles, whether totally or partially devoid of charges.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolysis and Metallurgy in Russia. ROSTIN. *Elektrochem Zeit.*, Sept. 1.—A description of these industries in that country; most of it is of little general interest. He states that the use of iron electrotypes is limited almost entirely to Russia, where the process was discovered; it is used only where the number of prints is a million or more, that is for bank notes, playing cards, etc.; tin plating is used largely as is also the recovery of tin from tin plate scrap; copper is refined and obtained from the ores by the electrolytic processes; acetic acid is purified electrolytically by a secret process, which is said to be very much cheaper than the chemical one; electrolytic bleaching is carried on; hydrogen is made commercially, both electrodes being iron, the electrolyte being a ten to fifteen solution of sodium hydrate as free as possible from carbonic acid gas; the anode is enclosed in a bag of vegetable parchment to prevent the gases from passing through; the voltage is about 2.5; the Benardos and Slawianow electric welding processes are used very largely; a process invented by the latter is also used for making large castings free from holes, slag and sand, the principle being to keep the upper layer fluid so that solidification begins at the bottom; this is accomplished by means of an electric arc maintained at the top of the casting which forms the positive electrode, the negative being steel or carbon; by this means very large castings can be made which would not be practicable by other methods; the current is 800 amperes at 70 volts, and the solidification lasts from three to eight hours; the castings have always been satisfactory so far.

Plating Aluminum.—Elektrochem. Zeit., Sept. 1.—A reprint of a short article giving a number of hints. A method is being tried consisting in first covering the aluminum by fusion or boiling with a thin adherent coating of a metal; in the former method metallic combinations are used which, in a reducing flame of low temperature are reduced to a metal which spreads evenly over the aluminum; after coating with these materials the object is heated; among other things the gold or silver paint used for the decoration of porcelain or glass may be used; other solutions are described. For coating by immersion in a boiling liquid, several solutions are described; one of these is a solution of zinc dust in boiling sodium hydrate; a solution of copper or iron chloride may also be used.

Alkalies and Bleach.—Elektrochem. Zeit., Sept. 1.—The conclusion of the long series of illustrated descriptions of the Kellner processes.

Electrolytic Production of Iodoform. ELBS and HERZ. *Zeit. f. Elektrochemie*, Aug. 20.—A process for making iodoform, broform, and chloroform electrolytically, has been patented for a number of years, the method being an electrolytic one and the original materials the halogen compounds in the presence of alcohol, aceton, etc., and heat; in the present article they describe researches made to find the details of the processes involved in making the first of these materials.

Experimental Study of Electrolytic Iron. HOULLEVIGUE. *Jour. Inst. Elec. Eng.*, July.—A longer abstract of the article which was noticed in the *Digest*, June 19.

Action of High Temperature on Various Sulphides. MOURLOT. *Zeit. f. Elektrochemie*, Aug. 20.—An abstract of a French Academy paper describing researches with a number of sulphides in the electric furnace.

Electrolysis of the Fatty Acids of Alkaline Salts. ROHLAND. *Zeit. f. Elektrochemie*, Aug. 20.—The first of a series of articles in which he discusses what takes place by such electrolysis and what the resulting products are.

Reaction of Carbon in Electrolysis. VOGEL. *Zeit. f. Ang. Chem.* 18-20.—After discussing the experiments made so far, he concludes that there is no prospect for succeeding with the complete combustion of carbon in a hydro-electric cell, and suggests that better results may possibly be obtained from the electrolysis of fused materials.

Electricity Directly from Carbon. FODOR. *Zeit. fuer Elek.*, Aug. 15. and Sept. 1.—A reprint of a recent lecture in which he gives a summary of the subject, including, apparently, nothing new.

Strontium Amalgam. GUENTZ and FEREE. *Zeit. f. Elektrochemie*, Aug. 20. Abstracted briefly from a French chemical paper.—Using mercury as a cathode and a concentrated solutio of strontium chloride, with a current of six amperes per square cm of cathode surface, they obtained this amalgam, which, after pressing in a leather bag, left a crystallized amalgam.

Improved Accumulator.—Lond. *Elec. Eng.*, Sept. 10.—A short article on the new Tudor accumulator, much of which is an abstract of the article of Blanchon, noticed in the *Digest*, Aug. 7 and Sept. 4; in the introduction, referring to traction accumulators, the economic advantages of traveling shorter distances and recharging more frequently are pointed out.

Chemical Analysis by Means of the Telephone. ERDMANN. *Berl. Berichte*, 30, p. 1175; noticed briefly in the *Zeit. f. Elektrochemie*, Aug. 20.—The conductivity of solutions of alkaline salts is approximately inversely proportional to their molecular weight; solutions of such salts may therefore be analyzed by measuring their resistances with a bridge and telephone; two arms of the bridge are made of a resistance wire and the other two vessels for containing the liquids, both being placed in the same water bath on account of the temperature; very good results were obtained in some cases, while in others the error was quite great.

Ionization of Solutions Containing Two Electrolytes. MACGREGOR. Lond. *Elec. Rev.*, Sept. 10.—An abstract of his British Association paper, the object of which is to draw attention to the possibility of determining in some cases what the coefficients of ionization must be in the case of two electrolytes in the same solution, having, or not, one ion in common but undergoing no chemical action other than double decomposition. The results of some of the observations are given; they show that ionization coefficients of the electrolytes in those solutions were accurately determined and tend to show that the dissociation theory enables us to calculate the composition of a solution containing two electrolytes with no common ion.

Reactions of Ions and Their Importance in Electro Chemistry. KUESTER. *Zeit. f. Elektrochemie*, Aug. 20.—A reprint of a recent lecture, which is a general discussion of the subject of reaction of ions; he speaks in terms of great praise of the Arrhenius theory of electrolytic dissociation.

Electro-Chemical Theories. MEWES. *Elektrochem. Zeit.*, Sept. 1.—The first part of an article in which he discusses the chief points of differences in the theories, which differences he believes are due to the kinetic theory; he therefore discusses them on the basis of the vibration theory and the mechanical theory of heat, in the most elementary possible manner; he

refers chiefly to the work of Nernst and of Bucherer, a knowledge of whose theories is taken for granted.

E. M. F. and Equilibrium of Partition. Bucherer. *Proc. Lond. Phys. Soc.*, Aug.; noticed briefly from the *Zeit. Phys. Chem.*, 22, p. 500.—A continuation of his dispute with Luther; he follows his former views and supposes all substances to be more or less dissociated, possessing a certain vapor pressure under all circumstances, and from these quantities he deduces the properties of solutions.

Electro-Copper Refining in the United States. Ulke. *Cassier's Mag.*, Sept.—An article giving a general description of the various processes used, together with some of the data and a few illustrations of some of the plants. There are in operation to-day eleven electrolytic refineries producing 342 tons daily, besides over 4,000,000 oz. of silver and 68,000 oz. of gold annually; considerably over half of the copper produced in the United States, or one-third of the production of the world, is now refined electrolytically; about five years ago the cost of this electrolytic refining was about $20 per ton and now it has been reduced to $8 per ton; a typical modern refinery of 30 tons daily capacity is described and the cost given; the average current is about 10 amperes per sq. ft., counting both sides of the anode plate, and it requires about 24 days of 24 hours to transfer the 275 pounds of copper from one anode to the cathode plates; the advantages of the series and multiple systems are compared; the multiple process is more commonly used than the series; he shows that there is a saving in operating expenses of nearly $2 per ton in favor of the multiple system.

Electro-Chemical and Electro-Metallurgical Industries in Europe. Kershaw. *Elty*, Aug. 25, Sept. 8 and 15.—The conclusion of his serial; in these portions he refers to France, Switzerland and other European countries and describes the soda and bleach processes in England, which includes the Richardson and Holland, and the Castner-Kellner processes; he includes several tablets of data. This series of articles is similar to one published in the English papers some time ago, and fully abstracted in the *Digest*, at that time.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Modified Clark Cell. Callendar and Barnes. Lond. *Elec.*, Sept. 10.—A reprint of a British Association paper, describing a very simple modified form of this cell, resembling in many respects the Board of Trade form, but more easily made and entirely free from the diffusion lag in changes of the E. M. F., due to changes of temperature; the latter appears to be the chief reason for the modification. This lag is much more serious in the existing forms than is usually supposed; they found, for instance, that by suddenly changing the temperature from 15 to 25 degrees C. the immediate change was only about half of what it should have been, and unless the cell be shaken it will take two or three weeks, or even a month, to reach its final value; this can be obviated by simply filling the cell entirely with moist crystals instead of using a clear saturated solution, and cells so constructed have no appreciable lag, the E. M. F. following accurately and immediately all changes of temperature between zero and 40 degrees; in one test the original value was restored within a tenth of a millivolt in about ten minutes; they found the Board of Trade test tube form more convenient and accurate than the H form, and in many cases they used hermetically sealed cells; they also confirm the fact that there is no practical difference in E. M. F. or temperature coefficient between cells of the usual pattern and those in which the mercury is replaced by a fine amalgamated platinum wire, such cells being also portable; instead of using a zinc rod they employ a 10 per cent. zinc amalgam. The same method of construction was also applied to the cadmium cells of Weston; they call their cells the "inverted" type.

Clark Standard Cell on Closed Circuit. Wulf. *Phil. Mag.*, Sept.—The results of some tests reported in the *Wiener Berichte*, July. He measured the difference of potential by means of a condenser, by which it could be measured at very short intervals after closing the circuit. The principal results are as follows: "1. The internal resistance of the elements used (cylindrical glass vessels, two cm in diameter, distance between the electrodes three-quarters cm) varied at ordinary temperatures between 40 and 80 ohms, according to the distance and magnitude of the electrodes. 2. The resistance varied considerably with the temperature, being trebled when it fell from 30° to 5°. 3. No diminution of the internal resistance with the strength and duration of the current could be ascertained. 4. With stronger currents of 0.005 ampere (external resistance, 200 ohms) polarization could be perceived even after 0.01 of a second; it increased but little during the first ten minutes, but afterward more and more rapidly. 5. On opening the circuit the polarization diminished in a few minutes to a small fraction; repeated short-circuiting through only 50 ohms' external resistance for more than a minute did not permanently injure the element. 6. When an element was closed for two hours through 200 ohms, by which its E. M. F. was reduced almost to one-half, in two minutes it attained its original strength to within 0.1 per cent.; but after this the polarization set in more rapidly and strongly."

Oscillographs. Duddell. Lond. *Elec.*, Sept. 10.—A reprint of a British Association paper, dealing with the continuous methods of recording alternating-current curves; he gives brief descriptions of the various forms which have been proposed and describing his own, which is a modified form of the method of Blondel, who suggested that a d'Arsonval galvanometer might be used if reduced to a bifilar suspension; it is this suggestion which is the basis of the present instrument, a brief illustrated description of which is given. In the small gap between the poles of the magnet two phosphor-bronze strips are stretched, the current flowing up one of the strips and down the other, thus turning them in opposite directions; a mirror is secured to them for reading the deflection; the motion of the spot of light is either photographed on a falling plate or observed in a rotating mirror; damping is provided by immersing the strips and mirror in oil; the final adjustment of the damping is made by varying the temperature and finding, experimentally, at what temperature the damping is correct. In a second form of the instrument there are two pairs of strips, each moving in its own gap, one pair being used for the voltage and the other for the current, a third fixed mirror being provided to indicate the zero line. The instrument has a very low self-induction and resistance, enabling it to be used both for current and voltage curves. In conclusion he gives a long list of references to papers and articles on the point methods and on the continuous methods.

Electric Curve Tracer. Rosa. Lond. *Elec. Rev.*, Sept. 10.—A brief abstract of a British Association paper, describing what is said to be a singularly beautiful arrangement for graphically determining the E. M. F. of an alternating current. A paper passes over a brass cylinder with an ink ribbon, so that when the pointer is depressed a dot is made; the long arm of a pantagraph carries a pointer moving along a stretched wire carrying a current, the middle point of the wire being connected to one terminal of the dynamo and giving the zero potential; as the pointer is moved over the scale the point over the cylinder moves through a proportional distance; an insulated disc carrying a contact piece connected with the second pole of the dynamo, is connected with the axle, thus making an instantaneous contact at each revolution with a brush which can be moved around the axle; the step by step rotation of this arm and the rotation of the brass cylinder are made simultaneously; a galvanometer is connected between the pointer and this brush, so that the former can be brought to a point of the stretched wire which is at the same potential as the dynamo terminal, and thus a mark is made on the paper at a distance proportional to the voltage or the armature in that position; a series of these marks gives the curve; the manipulation is very rapid and easy; a more complete description is promised.

Plotting Alternating-Current Curves. Abraham. *Bul. Soc. Int. des Elec.*, July.—A reprint of his complete and very long paper, with numerous illustrations, an abstract of which was given in the *Digest*, Aug. 7. It is followed by a list of fifty references to articles on this subject.

Electric Oscillator. Tesla. Lond. *Elec. Rev.*, Sept. 10.—A brief abstract, with a diagram, of his new form of induction coil, as described in a recent British Association paper. The original current passes through a condenser and a solenoid in series, the latter operating a make and break which discharges the condenser through the primary of an induction coil; the rush of currents from the mains charges the condenser through the coil, which attracts the armature and breaks the discharging circuit; when the condenser is charged the current in the solenoid falls off, releasing the circuit breaker and discharging the condenser through the primary of the induction coil; details of the dimensions are not given; the chief advantages claimed are that no fine wire or large number of turns is required on the secondary, although the quality of the effects produced and the efficiency of the apparatus is very great; sparks one foot in length were said to be produced with less than 10 watts.

Determination of the Ohm. Jones and Ayrton. Lond. *Elec. Rev.*, Sept. 10.—A brief abstract of two British Association papers on the Lorenz apparatus for determining the ohm, with special reference to the apparatus at the McGill University; the papers refer to the work done by these two authors in testing this apparatus; the first describes an improved method of calculating the coefficient of mutual induction of the fixed coil and rotating disc; the second paper deals with the result obtained, which differed by 5 parts in 10,000 from that previously obtained by Jones with his apparatus at Cardiff; as the present apparatus is superior in construction to any previously used, this value would reduce that of the true ohm in the proportion of 106.3 to 106.27. Jones urges the adoption of a Lorenz apparatus as the accepted method of testing standard resistances as against comparison by means of a bridge, with a material conductor. The subject is editorially discussed in Lond. *Elec.*, where attention is called to the fact that material conductors may change in the same directions, so that a comparison between them might not reveal the change; the present method, however, is an absolute determination and free from any material standards.

Condenser. Kleiner. *Beiblaetter*, 21, No. 4; noticed briefly in the *Jour. Inst. Elec. Eng.*, July.—He describes how a condenser can be made without hysteresis and air; it is made of a number of concentric copper cylinders filled in with paraffine.

Electrostatic Interference Electrometer. Perot. *Bul. Soc. Int. des Elec.*, June.—A reprint of the complete paper, with the illustrations, which was noticed in the *Digest*, July 3.

Registering Ampere and Voltmeters. Arnoux. *Bul. Soc. Int. des Elec.*, June.—A reprint of the paper describing his new instrument, which was noticed in the *Digest*, Sept. 4.

Artificial Cables. Vaschy. *Proc. Lond. Phys. Soc.*, Aug.—The concluding equations from the mathematical paper noticed in the *Digest*, July 10.

Method of Determining Magnetic Hysteresis. FLEMING. *Phil. Mag.*, Sept.—A reprint in full, with the tables, of the Physical Society paper noticed in the *Digest*, July 3.

Electrolytic Action and Insulation Resistance in a Condenser. GUTHE. *Elec. Eng.*, Sept. 16.—An abstract of a paper read at the A. A. A. S. meeting. He questioned whether the large change of resistance in a condenser is only due to the absorbed charge; he tested a commercial condenser and found that it acted like a cell which had been short circuited, recovering with the opening of the circuit; under these conditions it is nothing else than a high resistance battery, and he therefore measured its resistance as though it were such a battery; this method gave an entirely different result than the measurements by direct deflection, the result being only about one-thirtieth of that found by the latter method. Experiments were also made which showed the rapidity with which the condenser polarizes and recovers, the curves corresponding closely with those taken with ordinary cells. He also endeavored to determine how the surprising difference of the resistance of the dielectric depends on the time during which the circuit is closed. The general results deduced from his observations were that the dielectric resistance of a condenser in which electrolytic action was found increases with the time during which the current flows through it; and the time being constant the resistance seems to be smaller the larger the current. It seems clear, therefore, that the greatest accuracy and care be exercised in the proper selection of a condenser for alternating currents; the higher the frequency the greater will be the loss due to its small resistance, and he thinks the heat produced in most condensers is mostly due to the Joule effect and not to hysteresis. Almost all commercial paraffine condensers which show strong absorption also show traces of electrolytic action, and the two seem to be intimately connected.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephony in Sweden.—Zeit. fuer Elek., Sept. 1.—A reprint from a daily paper of a description of the telephone industry in Sweden, showing the very great extent to which the telephone is used in that country; the cost is extremely low; the systems are in the hands of the Government; the whole network includes at present 27,000 instruments, distributed over about 600 stations; the population is about 5,000,000, and there are about 100 cities, leaving about 500 stations for villages and towns; with few exceptions every city in the country is connected telephonically with every other, and there is scarcely a railroad town, or even a factory, which cannot communicate with any other in the country.

Electrophone. WRIGHT. Lond. *Elec. Eng.*, Sept. 10.—An illustrated description of this apparatus as it is used in the London theatres and opera houses, for enabling those connected with the telephone central station to listen to the performance. The transmitters are of the well-known Ader pattern and are usually placed, twelve to twenty-four in number, just in front or behind the footlights, being mounted so as not to be affected by the stage vibrations; the battery power is supplied by portable accumulators; an automatic apparatus opens the circuit when not in use. The receivers are also of the Ader pattern, having double poles, there being two receivers on one frame, for each person; it is necessary for a subscriber to be connected with a telephone system of that city; the receiver is put into circuit by means of a switch after the connection has been called for; automatic boxes which are operated by the insertion of a coin are also placed in some restaurants.

Telephone Middle Station. MATTAUSCH. *Zeit. fuer Elek.*, Aug. 15.—A description of the system of circuits by means of which two leads going to the central from different directions can be combined into one line, so that the two may talk to each other or each separately with the central, or with any of the other subscribers.

Disturbance of Submarine Cable Working by Electric Tramways. TROTTER. *Jour. Inst. Elec. Eng.*, July.—A reprint of the paper and discussion which was noticed in the *Digest*, June 12.

Development in Telephony and Telegraphy During the Second Quarter of this Year.—Elek. Anz., Sept. 7.—A brief review describing the principal recent developments, most of which have already been noticed in the *Digest*.

Montreal Telephone Station.—Can. Elec. News, Sept.—An illustrated description of the new building and equipment of the Bell Telephone Company, at Montreal. The switchboard is of the branch terminal multiple type, with an ultimate capacity of 4800 lines, of which at present 2500 are in use; the switchboard circuits are metallic throughout; miniature incandescent lamps are used as signals, glowing as long as the drop is down; the chief operator and the supervising operator can see at a glance how promptly calls are being answered; lamps are also used to show when inter-office trunk lines are not in use; the power used at the switchboard is obtained from sixteen storage batteries, charged with a motor generator.

Morse Telegraphy. ROYCE system. *Elec. Eng.*, Sept. 16.—A brief illustrated description of a system of a simple Morse telegraphy, with the aid of a wire along the track, with which contact is made with a brush, the chief feature of the system being that instead of the key closing the sounder circuit, it shunts the sounder with a short circuit, the contact points on the sounders being therefore reversed; what the real advantages of this method are is not clear.

MISCELLANEOUS.

Globular Lightning.—Zeit. fuer Elek., Aug. 15.—A brief description of an observation of globe lightning made last May.

Electricity Aboard Ship. KELLOGG. *Cassier's Mag*, Sept.—A well illustrated article describing many of the electric appliances used on board ship.

Rubber Substitutes. TERRY. *India Rubber World*, Sept. 10.—A reprint of the article noticed in the *Digest*, Aug. 21.

Tennessee Exposition. WILLIAMS. *West. Elec.*, Sept. 18.—A brief description, accompanied by a number of illustrations showing the principal exterior lighting effects.

Book Review.

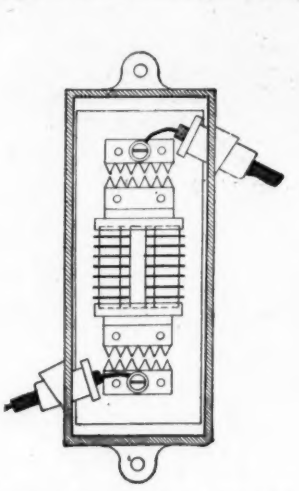
THE MECHANICAL ARTS SIMPLIFIED. By D. B. Dixon. Chicago: Laird & Lee. 497 pages, with illustrations.

This volume belongs to that class of technical hand books which are expected to serve as small-scale encyclopædias of the mechanic arts, and is intended, as its title page fully sets forth, for almost all sorts and conditions of people who are in any way interested in mechanical applications. Following the main portion of the book are what may be called two appendices. Concerning one, entitled "Electrical Department," occupying about 50 pages, it may at once be said that the author would have done well to have either entirely omitted it or submitted it to superior authority on electrical subjects. The electrical section includes the usual definitions of the electrical units, gives some plans for wiring and finding sizes of wires required, describes dynamo-electric machinery, instruments, etc., and finishes with the rules adopted by the N. E. L. A. at the 1891 meeting, which are to-day ancient history.

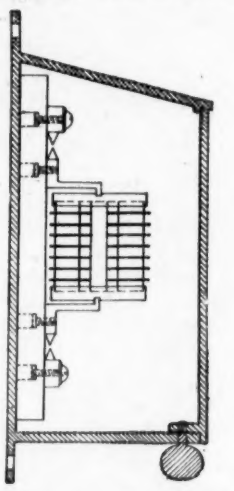
The clearness and accuracy of the descriptions may be judged from this one, of an alternator: "All machines that are used for lighting generate a simple two-phase current, which means that the current rapidly oscillates or changes direction." Another novelty is a table of incandescent lamps showing the current consumption of different lamps, those of candle-powers from 10 to 50 and voltages from 52 to 3000. The 2000-volt 16-cp lamp takes .0288 ampere! This information, alone, is worth the price of the book.

The Universal Non-Arcing Lightning Arrester.

A new form of the universal lightning arrester is shown in the accompanying illustrations. The two views are both sectional elevations, taken in planes normal to each other. The arrester depends on an interesting principle of static discharges. When a static discharge finds in its course



FRONT SECTIONAL ELEVATION OF ARRESTER.



SIDE SECTIONAL ELEVATION OF ARRESTER.

a number of paths of practically equal impedance, it splits itself among them all, owing probably to the strong mutual repellent action between its streams.

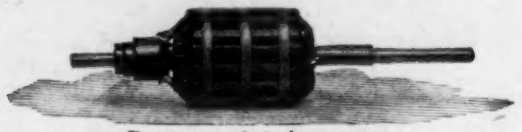
The universal arrester is made up of a number of circular discs of non-arcing composition, separated from each other by thin sheets of mica. A discharge jumps readily through these thin sheets of mica, as their combined resistance is much less than that of a single sheet of aggregate thickness. The discharge also, due to the principle stated above, divides itself into hundreds or perhaps thousands of little fine sparks through the mica, which do not have sufficient body to pull an arc.

This device thus does away with the necessity of fuses, magnets or moving parts.

The instrument is boxed in an iron case for use on open air work and electric cars. It has been put upon the New York market by Messrs. H. M. Shaw & Co., 126 Liberty Street, New York City.

Paragon Motors.

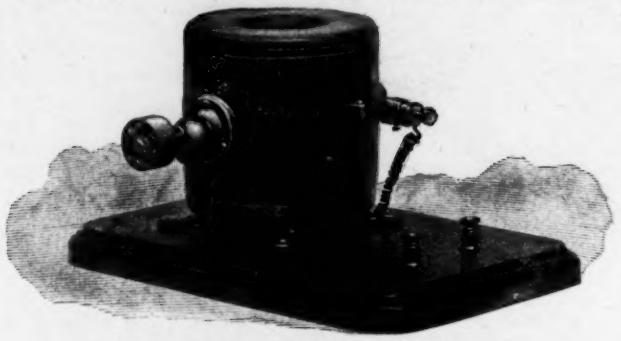
The Paragon motor, which has come into such favorable notice during the past season as a fan motor, is now being built in small sizes for general power-distribution purposes. The sizes now in stock are 1-12, 1-8, 1-4, 1-2



Paragon 1898 Armature.

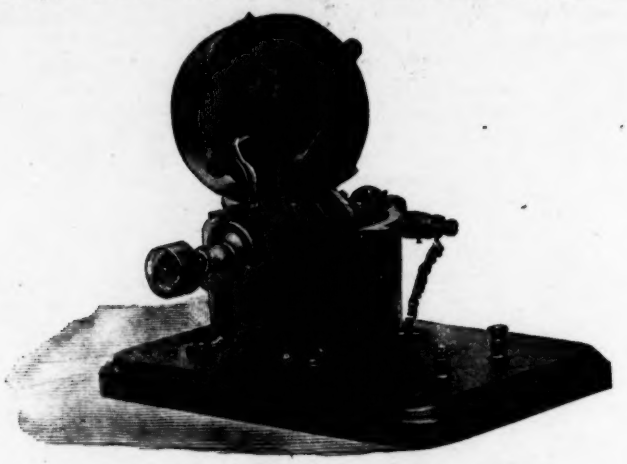
and 1 horse-power. This motor is peculiar in that it is designed and made with all the care that is usually spent on large units.

The general familiar features of the Paragon fan motor are embodied in these power motors, namely, iron-clad construction, enclosing everything



¼ H.-P. Paragon Motor, 1898 Pattern.

but the pulley, with the circular field and toothed armature. The new motors are made with an iron base, with the edge turned up to form an oil pan, and are fitted with radial brushes, the pressure of which is adjusted by a screw and lock nut. Owing to the excellent magnetic circuit,



Interior View of Paragon ¼ H.-P. Motor.

low air-gap reluctance, etc., the motors are of light weight and highly efficient for their size. The 1-2-hp size, for example, weighs only 60 pounds. They are also made up as small-size motor dynamos for the generation of alternating currents from direct currents, etc. These motors are handled by J. P. Williams, General Agent, 39-41 Cortlandt Street, New York.

New Bulletins of the General Electric Company.

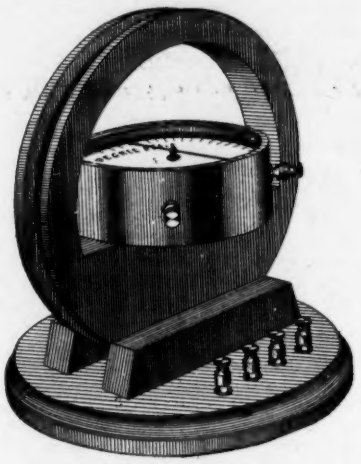
The General Electric Company has issued some new bulletins descriptive of the new types of apparatus which it is introducing. One of these describes a new Thompson recording wattmeter especially designed for street railway service. This meter differs from all previous meters of the same make, in having a laminated iron magnetic circuit. All meters made hitherto have been constructed with an air magnetic circuit, by which they are adapted for use on alternating as well as direct currents. An air magnetic circuit required the use of a good many coils of considerable power to give sufficient torque to the meter armature. The advantage of an iron magnetic circuit is that the same torque is derived with coils of greatly reduced magnetizing force and hence of greatly reduced current consumption. The iron core of the armature is not revolved, but is fixed on a bracket, the moving armature windings being cup-shaped and slipped down over it. The meter is also designed for security against injury when used on cars traveling over the roughest tracks. Injury to the jewel on which the moving parts rest is prevented by supporting it on a spring. To provide for the successive overloads of street railway practice, the meter is liberally under-rated as to capacity. It will record accurately steady overloads of 25 per cent. and brief overloads of 100 per cent.

Another General Electric bulletin describes new forms of apparatus for its series incandescent lighting system by alternating currents. The familiar Thomson reactive coil has been adapted to use as a regulator in these circuits, as an improvement over the old bank boards. A further improvement is provided by what is called the type M. R. feeder regulator. This feeder regulator is virtually an alternating booster transformer, with adjustable mutual induction between the primary and secondary coils. These two coils are respectively mounted in planes normal to each other around a cylindrical core, which can be turned to make the series coil either raise or lower the voltage. The adjustment is perfectly smooth and gradual, with no sliding contacts and no abrupt steps, no moving connections and no moving conductors.

A third bulletin of the same company describes the electric-lighting plants it builds especially designed for marine use. A table is given of the plants installed in freight and passenger steamships, yachts, ferryboats and battleships. The aggregate generator capacity installed amounts to over 6000 kilowatts, capable of operating over 116,000 16-cp incandescent lamps.

Electrical Apparatus for Students and for School Laboratories.

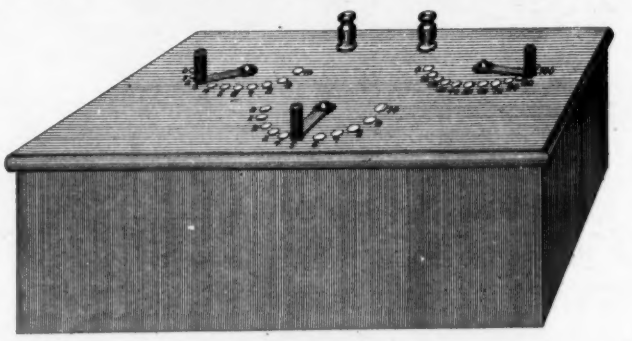
The introduction of the study of practical electricity into public schools, high schools, manual-training schools and night schools where lecture courses are given has shown that individual laboratory instruction is necessary to supplement the lecture-room demonstration, in order that the student should thoroughly grasp the principles taught. Such a laboratory for elementary experiments in electricity and magnetism should be organized and conducted as are the modern physical and chemical laboratories, with a complete set of electrical apparatus appointed for each student.



Combination Galvanometer.

The Palmer Electrical Instrument Company, 26 North Seventh Street, Philadelphia, Pa., has, after two years' experience, originated a complete set of electrical instruments for students' use, which fulfills two prime conditions: They are so manufactured as to be very moderate in price, making the equipment of such a laboratory inexpensive, and yet are durable and efficient enough to perform all experiments with as much a degree of accuracy as is requisite in such work.

A set has been successfully used in the electrical laboratories of the Spring Garden Institute, Philadelphia, and is of sufficient flexibility to permit of several hundred experiments in magnetism, voltaic electricity, elec-



Students' Bridge Rheostat.

tro-magnetism, electrical measurements, electromagnetic induction and dynamo-electric machinery.

The student's combination tangent and detector galvanometer, illustrated herewith, is neatly and durably made of thoroughly seasoned pine wood, the advantage of combining the two instruments in one being readily recognized. In the construction of the detector galvanometer a glass pointer fixed at right angles to the needle swings over a combination

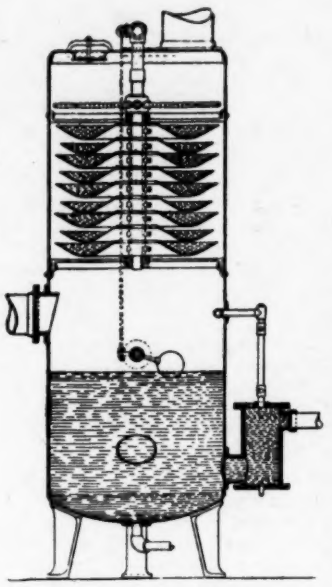
tangent and degree scale about 4 1-2 inches in diameter, the whole system being freely poised by a glass jewel on a steel point. The bobbin is wound with D. S. C. wire of about 25 ohms resistance, and a current of .0001 ampere through this galvanometer will produce a deflection of one degree. When properly shunted it can also be used as an ammeter, and a direct-reading scale substituted. The tangent coil contains four coils of two turns each, the terminals of two coils being brought out to binding posts on each side of the instrument, thus affording many exercises in series, parallel and series-parallel circuits. It can also be used as a differential galvanometer.

In the rheostat illustrated special spring brass arms swing around on brass buttons, especial care being taken to have a good wiping contact. The coils in the box are divided into tenths, units and 10-ohm divisions, the total resistance being 111 ohms.

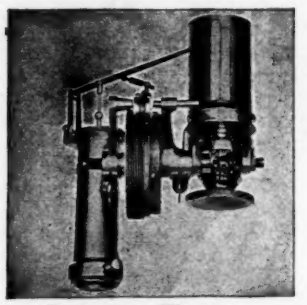
Feed-Water Heater and Purifier.

The accompanying illustration gives a cross-sectional view of the feed-water heater and purifier manufactured by the Pittsburg Feed-Water Heater and Engineering Company, of which the James Bonar Company, Pittsburg, Pa., is the general sales agent.

This heater is of the open cylindrical type. The cold water enters the upper part through a six-arm spraying device. Immediately below are



FEED-WATER HEATER.



REDUCING WHEEL.

arranged a series of dished pans, on a central shaft securely bolted in position. These pans are independent of each other, and can be revolved easily by the hands or lifted off through a door provided on the shell of the heater. The water flows from the upper to the lower pans, which are perforated on the inner edge, meeting the exhaust steam, which enters below the pans, passing upward to the outlet on top. The water having passed through the pans with increased temperature and leaving behind the greater part of its impurities, falls through the steam into the water reservoir and sediment chamber below.

An efficient blow-off device is placed at the normal water level, for the purpose of skimming off the oil and floating the impurities. A blow-off is also placed at the lower part of the sediment chamber. The height of water is controlled by operating a balance valve on the inlet feed pipe.

In order to prevent oil and impurities in suspension from entering the boiler a novel device is provided in this heater. A cylinder is attached to the side of the heater and connected to the water space by a large connection at an intermediate point, and is also connected to the steam space on top. The water to pump is taken from the separator, and it can be seen from the illustration that as soon as the water in the heater falls to the level of the pump connection the pump will automatically stop. No foreign matter can therefore reach the separator, hence nothing but the pure water reaches the boiler.

The heaters are large in area, to avoid any possibility of back pressure. They are made in all sizes, in either wrought or cast iron shells.

A Reducing Wheel.

The Buffalo Indicator Company, 52 Lake View Avenue, Buffalo, N. Y., is the manufacturer of the reducing wheel illustrated above. This wheel embodies the good points of the best wheels hitherto produced, besides some radical improvements. It is set up like an indicator, and works in a like manner, that is, in any and all directions by simple thumb and hand adjustment. No wrenches, screw drivers or tools of any sort are necessary in any adjustment of this wheel.

The reducing motion is mathematically correct, and the instrument works smoothly and noiselessly at all speeds. The main cord wheel and the change spools are made of aluminum, and the arms and spring case of brass, nickel-plated. Strength is one of the most important features of this wheel, which is suitable for strokes up to and including 72 inches.

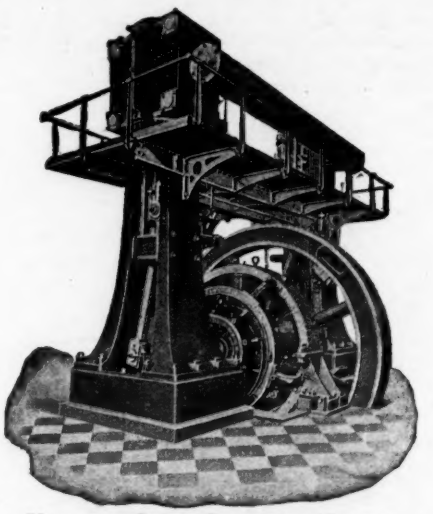
As the spring and spring case do not revolve the momentum is reduced to a minimum. Enclosed in the spring case is a light spiral spring which returns the cord wheel. This spring is adjusted for tension by unclamping the thumb nuts, turning the spring case by means of the knurled ring, and clamping the arms in the position desired. The cord wheel is only 2 3-8 inches in diameter, and engages with the spring at the hub. The pull is thus made direct through the wheel to the springs, and is not transmitted to the other bearings, thereby reducing friction and chance of breaking. The motion is then carried through the worm to the adjustable change spool. At this point adjustment is made for stroke by selecting the proper size spool and slipping it over the spindle, then clamping it with the knurled nut. Spools are marked for strokes for which they are best suited; there is, therefore, no calculation necessary. The paper drum of the indicator can be adjusted without untying the cord. Steady or spiral winding of the cord is obtained by the movement of the nut and arm over the end of the shaft, which gives an outward and inward feed to the swivel-feed pulley. This pulley is universally adjustable, and the cord can be fed to the cord wheel from any angle, and still give an even wrapping on the wheel. The tension when connected to the indicator is but a trifle stronger than that of the indicator alone.

A Vertical Cross-Compound Engine.

In the accompanying illustration is represented the vertical cross-compound engine erected at the works of the Western Electric Company, Chicago, Ill., by the Philadelphia Engineering Works, Philadelphia, Pa. This engine drives a 400-kw Western Electric generator, whose power is distributed to the different lines of shafting throughout the vast building. Its principal dimensions are as follows:

Diameter of high pressure steam cylinder, 22 inches. Diameter low pressure cylinder, 34 inches. Common stroke, 36 inches. Length of main journal, 24 inches. Diameter of main journals, 12 inches. Diameter main shaft at wheel seat and generator, 16 inches. Diameter of crank pin, 6 inches. Length of crank pin, 7 inches. Connecting rod, length 7 feet 6 inches. Connecting rod, diameter in centre, 5 1-8 inches. Piston rods, diameter 4 inches. Surface of each of the four cross-head slippers, 180 square inches. Throttle valve diameter, 8 inches. Fly wheel diameter, 6 inches. Weight fly wheel, 50,000 pounds.

This engine runs at the rate of 100 revolutions per minute, with a boiler steam-gauge pressure of 130 pounds. Its usual load is about 700 horse-power. It has been in operation since last June.



VERTICAL CROSS-COMPOUND ENGINE.

It will be observed that the dimensions of the cylinders are for non-condensing compound. These engines, however, are built for condensing compound by simply changing the proportions of the cylinders as may be required for the steam-pressure and power. The governor is positively driven. In this instance the distribution of power has been very well developed, and is really worth a visit from anyone interested in the distribution of power over large works and areas.

The form of these engines is especially designed for direct-connected work, as the inside of the frame is entirely closed, preventing either oil or water from injuring the generator.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, September 20, 1897.

ELECTRICAL STOCKS.—The advances in this list are Edison Electric Illuminating of New York and General Electric common and preferred. Edison Illuminating closed the week 8 points higher than the previous quotation. General Electric common closed at 1¾ higher. The highest price reached during the week was 41⅜, and the lowest 37 1-3, closing at 40¼. The total number of sales was 70,282 shares. The preferred stock is 4 points higher. New York Edison bonds are a fraction lower than the last quotation.

TELEGRAPH AND TELEPHONE.—The feature of this list is American Bell Telephone, which is rapidly approaching the 300 mark. It closed the week at 296½ bid and 297 asked. Erie is practically unchanged. In the telegraphs Western Union remained about steady, the sales of this stock during the week amounting to 43,456 shares. The price fluctuated within narrow limits, the highest quotation for the week being 96¾, and the lowest 95¼.

ELECTRIC TRACTIONS.—There are no marked changes to be recorded in this list. The market was quiet, little stock changing hands. Worcester Traction common was in good demand on advancing figures on the strength, it is supposed, of the satisfactory showing in earnings. The changes in prices all along the line were merely nominal.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	121	..
Edison Electric Ill., New York	100	131	135
Edison Electric Ill., Brooklyn	100	114	..
Edison Electric Ill., Boston	100	147	148
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	31¾	32½
Electric Storage, pref	100	33½	34¼
General Electric	100	40⅜	40¼
General Electric, pref.	100	87	90
Westinghouse Consolidated, com	50	25	..
Westinghouse Consolidated, pref.	50	55	56
BONDS			
Edison Electric Ill., New York, con. 5s	105	112¾	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb 5s	100	100½	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	296½	297
American District Telegraph	100	..	30
American Telegraph and Cable	100	..	94
Central and South American Telegraph	100	124	127
Commercial Cables	100	170	185
Erie Telephone	100	74½	..
New England Telephone	100	133	..
Postal Telegraph Cable	100	99	101
Western Union Telegraph	100	96⅛	96¼
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18¾	19
Brooklyn Rapid Transit	..	36	36⅛
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	77	79
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	40	42
Hestonville	100	49	49¾
Hestonville, pref	..	..	62½
New Orleans Traction	100	6	8
New Orleans Traction, pref	100	25	27
North Shore Traction	100	18	20
North Shore Traction, pref	100	80	83
Rochester Street Railway	..	19	21
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	110	..
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	98	98⅝
West End, Boston, pref	100	102½	..
Worcester Traction	100	16	18
Worcester Traction, pref.	100	90	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	96	..
*Buffalo Street Railway 1st con. 5s	100	109	111
Cleveland Electric Railway 1st mtge., 5s	100	102	104
*Columbus Street Railway 1st 5s	100	95	97
Rochester Street Railway 1st 5s	100	90	..
Union Railway (Huckleberry) 1st mtge. 5s	..	107	110
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, September 23, 1897.

MR. H. J. MEDBERY, of Mechanicville, N. Y., favored THE ELECTRICAL WORLD with a call a few days ago.

MR. C. C. WARREN, of the Warren Electric Manufacturing Company, Sandusky, Ohio, made a pleasant call at the office of THE ELECTRICAL WORLD during the week.

ASSIGNED.—Messrs. Edward P. Hampson and William F. Haring, constituting the firm of Edward P. Hampson & Co., dealers in machinery at No. 36 Cortlandt Street, have made an assignment.

ACCIDENT AT A BROOKLYN STATION.—A cylinder head blew out at the Pearl Street station of the Edison Electric Illuminating Company of Brooklyn at midnight, September 21, causing the extinguishing of street lights for the rest of the night. The business district of the city was affected by the accident.

NO CHANGE OF MOTIVE POWER ON THE ELEVATED.—Mr. George Gould, who arrived from Europe on September 17, in answer to an inquiry, stated that no plan is contemplated to change the motive power of the elevated railroads, contrary to all statements to the opposite effect.

SUIT TO RECOVER TAXES.—The Edison Electric Illuminating Company of Brooklyn has begun an action to recover certain taxes alleged to have been illegally and improperly assessed and collected. Orders have been served to show cause, before the County Court, on September 25, why an order should not be made directing the Common Council to refund the tax moneys in question.

TELEGRAPH TO THE KLONDIKE.—A dispatch from Seattle, Wash., states that the Western Union Telegraph Company is surveying the field with a view to extending its lines to Dawson, St. Michaels, and all other points of importance in Alaska. If the all-water route is chosen 4000 miles of cable will be required. Should the land and water route be chosen, 600 miles of wire and 900 miles of cable will be necessary.

TROLLEY CARS ON THE BROOKLYN BRIDGE.—A further change has been made in the plans for the trolley terminal at the New York end of the Brooklyn Bridge. Instead of having the four loops at an elevation of 50 feet from the ground level, as described in THE ELECTRICAL WORLD of August 28, they will be brought down to the street level. This will do away with the necessity for the twelve electric elevators, as planned. The intermediate platforms will be reached by a subway below the ground level, with steps up to each platform.

THE ANNUAL MEETING OF THE TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION will be held at the Western Union Building, this city, at 4 o'clock P. M., Wednesday, November 17. It is proposed at this meeting to amend Section 1, Article II., of the Constitution, so as to enable those who are not at the present time engaged in the telegraph, but who have been in such service at any time in the past, to join the association. Under the provisions of the Constitution, as it stands at present, only those who are actually in the telegraph service, and are otherwise qualified, are eligible to membership.

ELECTRICITY ON THE LONG ISLAND RAILROAD.—In his annual report to the stockholders of the Long Island Railroad Company President Baldwin stated that the directors are now considering the question of arranging with a tunnel company for a deep tunnel connection between New York City and the Flatbush Avenue station in Brooklyn, and the equipment of the line from New York City to Jamaica with electricity. With rapid transit service between these points, he states, it is expected that there would be a large development of long-haul passenger traffic, and a considerable growth of traffic within the territory which has been most seriously affected by surface lines.

PROF. SILVANUS P. THOMPSON, the eminent English electrical engineer and author, sails Sept. 25 on the Umbria for Liverpool. Prof. Thompson attended the meeting of the British Association at Toronto, and then went for an extended tour through the West. He has been in New York for the last week, and during his stay visited the office of THE ELECTRICAL WORLD. Professor Thompson says that he is much interested in surface-contact electric railway methods, and has been working for over a year on a system of this character, which he expects to bring out shortly. He expressed himself as having greatly enjoyed his American vacation, and having been much delighted with the many evidences of electrical progress which he saw in this country.

LONG ISLAND RAILROAD TUNNEL.—Men were set at work on September 21 making test borings at various points in Brooklyn to determine the conditions of the soil at the depth of the proposed Long Island Railroad Company's tunnel. This tunnel was originally planned by the late Austin Corbin, and was one of his hobbies for the improvement of the rapid transit facilities of Greater New York. The plan is to run the tunnel from the present Brooklyn terminal of the Long Island Railroad down to and under the East River, with a terminal station at a point near the corner of Cortlandt Street and Broadway, New York City. The original plan contemplated also the extension of this tunnel under the North River to Jersey City, there connecting with the Penn-

sylvania Railroad Company's system. The tunnel is to be bored by the Greathead system, as there is supposed to be no rock in the line of the work. The maximum grade in the tunnel will be limited to 4 per cent., with terminal stations in New York City about 70 feet below the surface, and in Brooklyn about 100 feet below the surface. The operation of the trains in the tunnel would be necessarily electrical, and the present idea is that the whole suburban system will be driven by the same motive power by the time the tunnel is completed.

RUMORS have been current for the past few days to the effect that the Amsterdam Electric Light, Heat & Power Company, of Brooklyn, has been bought out by one of the existing corporations with which the Amsterdam Company was organized to compete. The reports were emphatically denied by Capt. N. L. Cocheu, the general manager of the company. Mr. Cocheu stated that the company was about ready to enter the field as a competitor for the city's lighting as well as to supply private light. The area covered by the wires of the company is bounded by the East River front, Grand Street, Marcy Avenue and Division Avenue. Under the company's franchise it cannot charge more than 30 cents per arc light per night, and Mr. Cocheu states that the prospects for his company are very satisfactory.

THE KINGS COUNTY ELECTRIC ILLUMINATING COMPANY of Brooklyn, has, it is stated, secured a site for its station, having purchased the block fronting on the East River and John Street, from Bridge to Gold Streets, paying therefor $500,000. It is stated that fifty miles of subway have been laid, and that by the time the station is ready 100 miles of line will be available. It is the company's intention, so it is reported, to distribute power on the Tesla system, on account of the greater economy afforded by this system. Charles Cooper, who organized the company, was at one time willing, it is said, to dispose of the franchise for $50,000, but he now says that it could not be secured for $600,000. Bridge President William Berri, Bridge Trustee Keeney and ex-Congressman Felix Campbell have large holdings in the Kings County Company, and ex-Governor Flower, J. Pierpont Morgan and D. O. Mills are also said to be interested. In referring to the above-mentioned facts some of the daily papers gave varied accounts of the Tesla feature of the enterprise, one of them stating that the company had "purchased all the inventions of Nikola Tesla." Mr. Tesla has no personal interest in the company or its plans. He states that if it proposes to adopt his system of power distribution that all negotiations must necessarily have been conducted with one of the two principal electric manufacturing companies, which, under the business combination existing between them, control the patents covering this system. Mr. Tesla has no personal knowledge of the plans of the company.

THE GRAND CENTRAL STATION.—The work is now well under way on the rebuilding of the Grand Central Station of the New York Central & Hudson River Railroad and the New York, New Haven & Hartford Railroad, on Forty-second Street, New York. This station, which was one of the finest at the time of its erection, twenty-five years ago, is now somewhat inadequate to its needs. In its reconstruction something like $1,500,000 will be spent. The present lighting system will be entirely done away with, the generating stations in the yards being removed, and an up-to-date lighting plant will be substituted. This will be placed in the basement, and will consist of three 500-kw direct-connected generating sets, supplying current at 110 volts. The new station will contain some 5000 incandescent lamps and 105 enclosed-arc lamps, the latter being used to light the train shed. The arc-lamp circuits will be run separate from the main switchboard. The new station will be built to a height of six stories on the Forty-second Street side, with towers carried to a height of nine stories. In this part of the station will be situated the railroad offices, and the large passenger elevators will probably be electrically run. The same lighting plant will also supply current for the Railroad Y. M. C. A. Building, which is nearby, and 500 amperes will be used for arc lighting in the switching yards north of the station. The centre of distribution for these arc circuits is specified as a point on Forty-fifth Street, and the total drop of the system is limited by the specifications to 3 per cent. It is probable that some change will be made in these plans before the work is done. The waiting rooms of the different railroads will be consolidated under the new plans into one magnificent room in the Forty-second Street end of the building. The Vanderbilt Avenue side will be occupied by the baggage rooms, and from them the baggage will be distributed to the different platforms by a subway running under the tracks. At every one of the ten platforms a hoist will be provided, run by an electric motor. A telephone system, with 175 instruments, will also be installed in the building.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., September 22, 1897.

MAST-ARM PATENTS.—The Hope Electric Appliance Company, Providence, R. I., has instituted suit against the Russell Electric Manufacturing Company, of Providence, for infringement of its mast-arm patents, and has also filed a bill against the Narragansett Electric Light Company, of Providence, for using appliances that conflict with its mast-arm patents. The Hope Company asks for an injunction, and also for an accounting of the damage it has been made to sustain. The Hope Electric Appliance Company emphatically asserts that it possesses the foundation mast-arm patents, and that it is now its intention to aggressively assert to the electrical trade its position in reference to mast arm manufactures.

MR. C. E. BIBBER, hitherto manager and treasurer of the Bibber-White Company, Boston, has been elected its president, as well as its manager, succeeding Mr. Charles A. White, recently deceased. Mr. E. L. Brown, who has held the position of assistant treasurer, has been elected treasurer. In appreciation of its loss and also of his valuable services and personal worth, the Board of Directors of the company has passed appropriate resolutions to the memory of Mr. White. Mr. Bibber has all along been the active official of the company, and its present excellent business is unquestionably largely due to his well-known indefatigable energies together with the hearty co-operation of Mr. White, between whom and Mr. Bibber always existed the strongest friendship and business unity.

DEATH OF MR. C. A. WHITE.—Mr. Charles A. White, president of the Bibber-White Company, Boston, died at his residence at Malden, Mass., Thursday, September 16, and his funeral, which was largely attended, occurred the following Saturday, September 18. The funeral services were extremely impressive, and the casket was literally buried in handsome floral tributes. Mr. White's death is deeply regretted by a large circle of friends in the electrical field, to whom he had strongly endeared himself through business and social intercourse. Aside from his connection with the Bibber-White Company, Mr. White had been actively identified for over eight years with the Eco Magneto Clock Company, of Boston. He was also ex-president of the Malden Common Council. Years ago he was prominently engaged in the lumber business in New Haven, Conn. A widow and two sons survive the deceased.

MR. GEORGE W. ADAMS, universally known throughout the electrical fraternity as "Happy" Adams, died at his residence in Dorchester, Mass., on Saturday, September 11, his funeral occurring on Tuesday, September 14. Mr. Adams had for upward of a year been confined at home, and his death was by no means unexpected. Now that he is gone, his many friends will recall his admirable qualities of heart and mind, and particularly his always exceeding geniality, which brought him the designation of "Happy" Adams. Mr. Adams was truly an "old-timer" in electrical matters, was associated with electric lighting in its earliest days, and installed the first lighting machine in Boston. He did not, however, continue in the lighting field, being compelled to devote his entire energies to the Boston Electric Protective Association, organized by him about twenty years ago, and of which he was general manager up to the time of his death. Mr. Adams was very prominent in Masonry and Grand Army matters, was a member of the Ancient and Honorables of Boston, conspicuous in club life, and his large funeral and floral offerings evidenced abundantly the high esteem in which he was held. A widow and daughter survive him.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., September 20, 1897.

TRAIN LIGHTING.—Mr. Chas. A. Gould, the Buffalo inventor, and owner of the Gould car coupler, has perfected a complete electric system for lighting railway cars. The light is said to be very steady and clear, and costs about the same as the Pintsch gas now in use. It is expected to take the place of all other car-lighting apparatus before long.

THE NEW DEPEW & BUFFALO ELECTRIC ROAD is in the hands of the State Railroad Commission for a permit. President Cole and Secretary De Freest of the commission last week went over the ground with W. B. Cutter of the new road, but nothing is yet known of their conclusions. There is one electric road to Depew and Lancaster, which runs its cars to Main Street in Buffalo, and this is, of course, opposing the new venture.

THE BUFFALO TRACTION COMPANY appears to be as far as ever from running its cars, in spite of announcements. All sorts of delays are reported. It may be November before it has cars on the street. It is claimed and also denied that the Buffalo Traction Company is behind George P. Smith in his efforts to extend his trolley line to Niagara Falls. It is the original one between Buffalo and Tonawanda, and is now said to have enough money behind it to build the rest of the line northward from Tonawanda.

CHLORATE OF POTASSIUM BY ELECTRIC PROCESS.—The current of the Niagara tunnel is to be used for the manufacture of chlorate of potassium, the only venture of the sort in the United States. The company is composed mainly of Buffalo men, Edward Michael, of Buffalo, being president. Last year the United States imported 5,500,000 pounds of potassium chlorate, but the Dingley bill made its home manufacture possible by imposing a tariff of 3½ cents a pound on the product. The electrical process of manufacture was invented by Gibbs & Franchot, of Canada. The contract for the plant is given out. It will be built at Niagara Falls, and 1000 horse-power will be taken from the tunnel.

ELECTRIC GRAIN ELEVATOR.—The Northern Elevator, a steel structure of 3,000,000 bushels capacity, is about ready for business. As it is to be operated by electric power, it is a double novelty here, all the other elevators being of wood and run by steam. One novel feature is the taking in of the grain from vessels by three movable legs, which run on a track on the dock. To connect them with the stationary motors in the building a trolley system will be employed. The building will be filled with motors, wherever power is to be applied. A second steel elevator, to be called the "Electric," and controlled by Messrs. Kneeland & Co., New York, grain dealers, will also be ready for business this fall.

ELECTRIC POWER TOWING.—It appears that the invention of Richard Lamb of a motor towing system for canals, which he used for towing logs in his Southern lumber swamps, is to be used in Germany before it is ready for the Erie Canal. A motor, much improved from the one tested last year on the canal at Tonawanda, has been shipped by the Trenton Iron Company to a German canal company. The motor used here was an unwieldly affair, and not only had to be carried under bridges by means of ditches to keep it from the ground, but it weighed 3000 pounds, which, with the man to operate it, was too much to carry on a wire strung on poles. Now the weight of the motor has been reduced to 1300 pounds, and is 5 feet long instead of 9. The worm gear has given way to spur gear, two reductions in speed effected, and the pulling capacity of the motor increased one-half. It is not stated whether the Cataract General Electric Company will make any more canal experiments this season, but it looks as if it would wait till next year.

Pittsburg Notes.

Pittsburg, Pa., September 20, 1897.

HOME TELEPHONE ORDINANCE HELD UP AGAIN.—At a meeting of Select Council, held in Allegheny on September 15, the ordinance granting rights of way to the Home Telephone Company was considered and laid over for thirty days. This ordinance was recommended by the committee on corporations for passage, but owing to the absence of two of its supporters in Select Council it was evident that it could not pass at this meeting, and its friends succeeded in securing a postponement of action upon it for thirty days.

TROLLEY CARS TO BE USED FOR FUNERALS.—The Mt. Troy and Reserve Township Traction Company's line was completed and put into operation last week. This road runs from Allegheny through Reserve Township into Evergreen Valley. Along its route are no less than four large cemeteries, which, at certain seasons of the year, are difficult of access on account of bad roads. For this reason it has been decided to provide the road with specially equipped cars that will be used only for funerals. One car will be appropriately fitted out for the transportation of the coffin, and others will be suitably arranged to carry the funeral party. Since this is the first road in this vicinity to run funeral trains, its operation will be watched with considerable interest.

THE WESTINGHOUSE COMPANY'S ENGLISH ORDER.—Referring to the contract received by the English representative of the Westinghouse Electric & Manufacturing Company, which was briefly noted in the last issue of The Electrical World, it will be of interest to state that it calls for the delivery of the apparatus before July, 1898. It will include three direct-connected multiphase dynamos of about 2000 horse-power each, together with three engines of suitable size to drive the same. The engines, which will be built by the Westinghouse Machine Company, will be of the vertical compound-marine type. Like the dynamos, they will be constructed on the same plans as those recently installed by the Allegheny County Light Company, of this city.

LORD KELVIN IN PITTSBURG.—Lord Kelvin and Lady Kelvin arrived in Pittsburg last Thursday morning on the private car of Mr. George Westinghouse, which had been sent to Chicago to receive them. They spent the following twenty-four hours as guests of Mr. Westinghouse. A large portion of the day was spent by Lord Kelvin at the Westinghouse Air Brake Works in Wilmerding, and at the works of the Westinghouse Electric & Manufacturing Company, and the Westinghouse Machine Company in East Pittsburg. The distinguished visitor evinced great interest in all that he saw at these establishments. At East Pittsburg he had an opportunity to inspect one of the seven 5000-hp dynamos that are under construction for the Niagara Falls Power Company. The first of these is now completed, and is about ready for shipment. The Kelvin party went East early on Friday morning.

Cleveland Notes.

Cleveland, Ohio, Sept. 18, 1897.

NEW TELEPHONE LINES.—New telephone lines are about to be constructed between Ravenna and Garrettsville, and between Ravenna and Cuyahoga Falls.

NEW DISTRICT TELEGRAPH COMPANY.—The Akron District Telegraph Company was incorporated September 17 by John W. Miller, Marvin J. Galloway, Homer A. Hine, George E. Felver, E. D. Eckrode and James P. Loomis. The capital stock is $20,000.

NEW ELECTRIC LINE.—The work of laying the rails of the Cleveland, Painesville & Eastern Railway Company's lake shore electric line, which was commenced in July, is being pushed rapidly forward. It is expected that the new line will be in operation this fall. Cars will enter the city by the St. Clair Street line.

BIG RAILWAY SCHEME.—Mr. Henry C. Payne, the Milwaukee railroad magnate, with ex-Secretary of State Daniel J. Ryan and Charles F. Pfister, a wealthy capitalist of Milwaukee, were in Cleveland a few days ago. They held a conference with Senator M. A. Hanna, Col. Myron T. Herrick, C. W. Collister and others relative to a big railroad scheme, having for its object the purchase of several roads now in operation, and the building of several other roads to make the connecting links of a system which would be several hundred miles in extent.

MR. TOM L. JOHNSON IS OUT.—The Tuscarawas Electric, which operates the railway between Canal Dover and New Philadelphia, has left the control of its original builder, Tom L. Johnson, and is now controlled by local capitalists, with one outsider, Mr. L. P. Wentz, of Sutton, Neb. Theodore Wentz, and David King, a wealthy retired merchant, have bought $50,100 worth of stock. Consolidation with the Tuscarawas Railway line between New Philadelphia and Uhrichsville is thought to be further off than ever.

LINE ABANDONED.—The Cleveland Electric Railway Company filed its answer in Common Pleas Court Monday, to the suit for an injunction brought by the city to prevent it from tearing up its tracks on Murray Hill Avenue. The Railroad Company says it never made any agreement to run its cars over Murray Hill Avenue for any specified period. It says it is for the benefit of its patrons to extend the Cedar Avenue line and run its cars out to the new barns on Euclid Avenue. The growth of the city has made it necessary to put all the cars possible on Cedar Avenue and abandon the Murray Hill line.

REDUCTION OF FARES ON STREET CARS.—This question, which has been engrossing the attention and time of the members of the Cleveland City Council for the past two months, is now being taken up by the general public, as is evidenced by the number of public meetings being held in the different wards of the city for the discussion of this question. Mayor McKisson is taking a prominent part on the side of lower fares, claiming that the railroads of this city, at their legitimate cost for construction, maintenance and operation, could afford to carry their passengers at a much lower rate than 5 cents, and at the same time earn a good dividend for the stockholders. It is claimed, however, by the other side, that a lower rate of fare would lead to poor service and a reduction in wages to the employees. At a mass meeting held Friday evening, September 17, in the Music Hall, a protest was entered against the Hopkins 3-cent fare ordinance.

ANOTHER SUBURBAN.—Another electric railroad will soon connect Cleveland and Akron. The line known as the Cleveland & Electric Akron Railway, which was incorporated in 1894, has passed into new hands, and the enterprise is to be pushed to completion. It was originally intended that the road should run over the public highways, and for this a franchise was secured, but later it was determined that for a comparatively small expense the right of way through private property could be had, and a better and shorter route secured. The new line, it is said, will be several miles shorter than the Akron, Bedford & Cleveland line, now in operation. It will connect with the Big Consolidated at a point less than three miles from the Public Square, but just where, the promotors of the scheme decline to say. The road will pass through Herbsts, Walling's Corners, Brecksville, West Richfield, Hammond's Corners, Bath, Ghent, Montrose and Fairlawn. It is said that farmers along the new route are anxious to have the road completed, and there is not an obstacle of any consequence to overcome.

Southern Notes.

Washington, D. C., Sept. 20, 1897.

THE COMPLETION OF THE TELEPHONE LINE to Snow Hill, N. C., by the Kinston Telephone Company, is announced.

A TELEPHONE LINE from Elkin to Sparta, N. C., has been completed, and the people of the two towns are now on speaking terms with one another.

THE BELL COMPANY IN RICHMOND.—The record in the case of the City of Richmond against the Southern Bell Telephone Company has been sent to the United States Circuit Court of Appeals. The case will be argued the second week of the November term, and an opinion will probably be rendered by February. The opinion is expressed that the ruling of Judge Goff will be somewhat modified, if not reversed, by the higher court.

TELEPHONE EXTENSIONS IN NORTH CAROLINA.—A telephone system for Wilkesboro is to be established at once, a local telephone company having been organized for the purpose. Permission has been granted to Mr. S. J. Fair, of Walnut Cove, by the County Commissioners, to construct a telephone line from Walnut Cove to Winston, with stations at Dennis, Walkertown and Fulp. Permission has also been granted to Mr. J. F. Miller and Sheriff Kapp to make a telephone connection with Bethania, via Fulp and Rural Hall, to Winston.

THE HON. ALFRED E. MORLAN, United States Consul at Belize, British Honduras, has forwarded to the State Department a copy of the specifications for an electric-light plant that is wanted there, and is being advertised for. The three-wire system is desired, and the specifications call for boilers, engines, dynamos, accumulators, copper mains, flexible leads, iron lamp standards, switches, fuses, incandescent lamps, arc lamps, meters, etc. Tenders should be addressed to and should reach Mr. A. R. M. Simkins, care F. Otto, Tower Chambers, Moorgate Street, London, E. C. (Telegraph address "Helios," London), not later than October 20, 1897, and should be enclosed in a sealed package marked, "Tender for electric lighting." The district board of Belize does not bind itself to accept any or the lowest bid.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Sept. 20, 1897.

ONE SET OF POLES FOR SIX ELECTRIC COMPANIES.—The six electric companies operating on the South Side have come to an agreement, whereby but one set of poles will be used for the wires of all the corporations interested. This will result in the removal of several thousand poles now used in supporting overhead wires.

STATE STREET BRIDGE ELECTRICALLY OPERATED.—The City Engineer reports that the electrical operating machinery of the State Street bridge is now complete. On September 10 the bridge was swung by electricity for the first time. Every bridge on the river, between Randolph Street and the Lake, is now operated by electricity.

CONSOLIDATION RUMOR.—It is rumored that there is a prospect of consolidation of the traction interests in this city controlling all the surface street railway lines. The negotiations are said to have gone far enough to warrant the belief that within twelve months every street railroad in Chicago will be under the management of the single executive head, Mr. Charles T. Yerkes.

CHICAGO EDISON COMPANY'S PURCHASE.—The Chicago Edison Company has purchased the property on Twenty-first Street, between Wabash Avenue and State Street, belonging to the Chicago Illuminating Company, which has electric lines running through the South Side. The company's investment was $200,000 to $250,000, and the selling price is about half the former amount. The purchase was made from Henry Greenebaum and others representing the creditors. The Illuminating Company has been a rival of the Edison.

Milwaukee Notes.

Milwaukee, Wis., Sept. 20, 1897.

HARTFORD, WIS.—The Hartford Plow Works will install an electric-light plant for city lighting.

TO ENLARGE THE PLANT.—William Plankinton is receiving figures for the installation of a 125-kw direct-connected unit. This unit will be added to the present power plant of the Plankinton House, Milwaukee, Wis.

MESSRS. ROHN & MEYER, Milwaukee, have closed a contract with the Pfister Vogel Leather Company to wire the latter's new tannery building at Bay View for electric lights. Two hundred and fifty-volt lamps will be used.

General News.

NEW INCORPORATIONS.

THE ELMWOOD TELEPHONE COMPANY, Elmwood, Ill., has been incorporated by Marshall T. Lott, E. Gabriel, T. J. Morton, John Clinch and E. H. Dillon.

THE CITIZENS' ELECTRIC LIGHT COMPANY, Lake Geneva, Wis., has been organized for the purpose of operating an electric-light plant. Capital stock, $10,000.

YUBA ELECTRIC LIGHT & POWER COMPANY, Sacramento, Cal., has been formed with a capital stock of $160,000, by John Markley, Walter Longbottom and Hiram W. Johnson.

THE CONTINENTAL LIGHTING COMPANY, of Newark, N. J., has filed articles of incorporation. The directors are Ragland Momand, George W. Mack and Howard K. Wood. Capital stock, $100,000.

THE MULBERRY STREET PASSENGER RAILWAY COMPANY, Trenton, N. J., has been incorporated with a capital stock of $12,500. The directors are Henry C. Moore, Judge Robert S. Woodruff and Frank Abbott.

THE LEWISBURG, MILTON & WATSONTOWN PASSENGER RAILWAY COMPANY, Milton, Pa., has been formed, with a capital stock of $125,000, for the purpose of building an electric road from Lewisburg to Milton.

THE FLUSHING UNION GAS COMPANY has been incorporated at Flushing, L. I., for the purpose of manufacturing gas and electricity for distribution in this place and adjacent towns. Those interested are James H. Joarden, Edwin Ludlam, Walter K. Rossiter and others. Capital stock, $25,000.

THE NATIONAL ELECTROLYTIC COMPANY, Evans, N. Y., has been incorporated at Albany, with a capital stock of $200,000, for the purpose of manufacturing and dealing in chemical compounds. The directors are Charles W. Hackett, Utica; James A. Roberts, Henry Koons, Tracy C. Becker, Buffalo; S. P. Franchett, William T. Gibbs, Buckingham, Quebec.

THE TELEGRAPH AND TELEPHONE.

CENTRALIA, MO.—A telephone company is being organized in this place.

ROLAND, IOWA.—A new telephone line from this place to McCallsburg has been completed.

SHERIDAN, MO.—The Sheridan Telephone Company is talking about extending its line from Gaynor City to Hopkins.

ITHACA, MICH.—In order to make both ends meet the Board of Directors of the Gratiot County Telephone Company has found it necessary to increase the rentals from $3 to $4 per month.

VICKSBURG, MISS.—The Great Southern Telephone Company is building a long-distance line between this city and Jackson. The line will be equipped with two metallic circuits, one for through and one for local service.

SEYMOUR, IOWA.—The Seymour Telephone & Construction Company has completed arrangements for the construction of a telephone line from Centreville to Seymour, via Jerome and Mystic. Work will be begun on the line immediately.

CHATTANOOGA, TENN.—The East Tennessee Telephone Company has finished a long-distance line from here to Benton, Pope County, a distance of 45 miles. The company expects soon to close the gap in its lines through from here to Nashville.

SALINA, KAN.—A telephone line from Junction City will be extended to this place, thence to Bennington, Minneapolis and northward into Nebraska. A toll line southward to Hutchinson will be built and connected with the line already in operation there.

DETROIT, MICH.—The Michigan Telephone Company has reduced the price of its telephones in business places. The old company is reducing the tariff for talking over its toll lines to towns in the neighborhood of Detroit from 25 cents to 10 cents, and lowering all 50-cent tariffs to 25 cents.

ASTORIA, ILL.—The Fulton County Telephone Company is putting in a fine system. A metallic circuit has been established and the lines extended, covering the whole of Fulton County, and much of Schuyler and McDonough Counties, connecting with Beardstown. Peoria and Galesburg will also be reached.

INDIANAPOLIS, IND.—After a hard and victorious fight with the Bell Telephone Company, Mr. W. J. Kurtz, president and manager of the National Telephone Company, together with Mr. P. A. McDonald, has arranged to provide Anderson, Ind., with a new telephone company that will have no trouble in giving the citizens there cheaper and better service. Bonds and franchise are ready. Mr. Kurtz is at the head of a co-operative company at Indianapolis to accomplish the same results. In St. Louis 5000 instruments are being installed, and in West Point, Ga., 100 telephones are now in operation. One hundred additional telephones are being put in at St. Joseph, Mo., making 600 in all at this place, and Muncie, Ind., is operating 225 instruments.

LOWELL, MASS.—Mr. Charles J. Glidden, vice-president of the Erie Telephone Company, Lowell, Mass., referring to the advance in price of Erie Telephone stock to 75, its highest point, quotes the report of one of the company's superintendents, dated September 1, which says: "While it is true we have increased the facilities 50 per cent., the business has increased 100 to 150 per cent." Mr. Glidden gives two reasons for the growth in the telephone business—the increase in population and the continued education of the people in the use of the 'phone, and adds: "The telephone has been with us now twenty years, and I fail to find a record of any of the Bell interests becoming embarrassed. There is not a Bell Company in existence but what has paid its stockholders a satisfactory dividend. Hard times may check the growth of the telephone, but never until population begins to decrease will the telephone business diminish."

ELECTRIC LIGHT AND POWER.

NORTH MANCHESTER, IND.—The electric-light plant has been destroyed by fire.

TULLAHOMA, TENN.—E. J. Mitchell, of Huntsville, Ala., has been granted a franchise to operate an electric-light plant in this city.

RENSSELAER, IND.—This city has purchased the electric-light plant, including General Electric apparatus, for $7740.

WILLIAMSPORT, PA.—The contract for lighting the town of Jersey Shore has been let to Messrs. Grant Sweet and C. W. Hill.

INDEPENDENCE, MO.—The electric-light plant at this place was sold at auction and bid in for $5000 by the Citizens' Electric Light Company.

FERNANDINA, FLA.—The municipal lighting plant will be removed, a new power house will be erected and additional machinery will be purchased.

ROCHESTER, N. Y.—The City Electrician has been instructed by the Executive Board to remove all overhead wires, except the street railway wires.

WILKESBARRE, PA.—The contract for supplying the town with electric light has been awarded to the Scranton Electric Construction Company, at $18,000.

PERU, ILL.—At a meeting of the committee having charge of the city electric-lighting works, it was decided to recommend the purchase of a new engine and two new dynamos.

DELTA, PA.—The Delta Electric Power Company has the erection of the machinery in its new water-power plant almost completed. The work on the line will be commenced soon.

LOUISVILLE, KY.—A Louisville firm has been awarded the contract for the new steam and lighting plant for the Western Kentucky Lunatic Asylum. The contract price was $19,280.

PLAINFIELD, N. J.—The City Council has decided to use arc lights for street illumination in place of the incandescents previously used. Eleven arc lights will be set up immediately.

LACONIA, N. H.—The Laconia Electric Lighting Company was granted a permanent franchise to extend its wires to the water in East Tilton or to add to its business in any other direction.

SALT LAKE CITY, UTAH.—The City Council of Payson has made an appropriation of $2000 to purchase the plant and fixtures of the Payson Electric Light Company from the assignee.

CASSELTON, N. DAK.—The City Council of this city has decided to put in an electric-light plant at a cost not to exceed $6000. The city has enough cash in the treasury to pay out this sum.

NEW ORLEANS, LA.—The contemplated plan to place all telephone, electric-light and power and telegraph wires under ground is receiving the attention of the fire and lighting authorities of this city.

SYRACUSE, N. Y.—The Messrs. Smith & Newton, of Syracuse, have procured a refusal of the old Hill property at the corner of James and Elm Streets, and will at once erect an electric-light plant on the site.

DAVENPORT, IOWA.—The Davenport Consolidated Gas, Electric Light & Steam Heating Company is laying pipes through the streets for the purpose of delivering steam to business houses and residences for heating purposes.

HAMILTON, OHIO.—Five motors have been installed in the works of the Mosler Safe Company for running the machinery, in place of steam engines. The power will be supplied from the electric-light plant at East Hamilton.

SCRANTON, PA.—The light committee of Mayfield Council waited on the Jermyn Electric Light Company a few days ago, and, as a result, the residents of that town will be given a chance to light their homes with incandescent lights.

GRAND RAPIDS, MICH.—The Edison Light Company of this place has decided to run mains through the streets for the supply of heat by exhaust steam. The company was required to file a $10,000 bond to provide against any infringement of public or private rights.

HARTFORD, CONN.—The burned plant of the Farmington River Power Company, at Poquonnock, will be immediately rebuilt. This is the plant which it will be remembered supplied power for Hartford, Conn. A substantial fireproof structure 70 by 40 feet will be constructed of brick and iron, probably by the Berlin Iron Bridge Company. Experts of the electric companies have been on the field to figure on the electrical work to be done.

THE ELECTRIC RAILWAY.

BRISTOL, N. J.—An electric railway from Bristol to Newtown is now a possibility of the near future.

ST. JOSEPH, MO.—The street railway company proposes to extend its lines to the Stock Yards. W. T. Van Brunt is general maanger.

BANGOR, ME.—W. D. Smith & Co., of this city, have taken the contract to build the extension of the Franklin, Somerset & Kennebec Railway to New Sharon.

PENN YAN, N. Y.—The projectors of the Savona Valley & Keuka Electric Railroad, which has been talked of so long, have applied to the State Board of Railroad Commissioners for a charter.

BALTIMORE, MD.—Application was made to the County Commissioners at Towson for a franchise for the Baltimore, North Point & Bear Creek Electric Railway. The proposed road is to run to Mt. Carmel.

MORRISVILLE, VT.—The first electric railway in the State north and east of Burlington, is rapidly nearing completion. It runs from Waterbury to Stowe. The new line will be 10 miles in length, and will carry both freight and passengers. The rails are heavier than those ordinarily used for electric roads,

and freight cars from steam roads will be run over them, so it is stated. It is expected that the line will be in operation by December 1 next.

CHATTANOOGA, TENN.—It is now believed that the electric car line from this city to Chickamauga Park is a certainty. A company has recently been organized, and it is stated the work of construction will be commenced in a very short time.

PROVIDENCE, R. I.—The Woonsocket Electric Company is installing two Armington & Sims engines of 125 and 65 horse-power, respectively, in its Main Street station, for the purpose of driving railway generators when the water in the river is low.

HARRISBURG, PA.—The Southwestern Street Railway Company to run an electric road 8 miles long in Philadelphia, has been chartered at the State Department with $48,000 capital. E. A. Tennis is president; H. M. Van Zandt, W. H. Hassenplug and W. J. Burns are directors.

DEPEW, N. Y.—The State Railroad Commission gave a hearing on the application of the Buffalo & Depew Electric Railway Company for permission to construct its proposed road between Depew and Buffalo. The granting of the application is opposed by the Buffalo, Bellevue & Lancaster Railroad Company. The Commission reserved its decision.

CLEVELAND, OHIO.—The gross earnings of the Akron, Bedford & Cleveland Suburban Railway for the month of August were $11,750, and for the Cleveland, Painesville & Eastern Electric Railway, $8901. In both instances the earnings exceeded those of August of last year. The gross earnings of the Chagrin Falls line for August were $13,992.

Trade and Industrial Notes.

THE PHOENIX IRON WORKS COMPANY, Meadville, Pa., has secured the exclusive rights in the patents of the Moyes combine water-tube boiler, to manufacture and sell this boiler.

CAPITAL INCREASED.—The business of the American Rheostat Company, Milwaukee, Wis., is growing to such an extent that it has been necessary to increase the capital stock of the company to $25,000.

THE PACKARD LAMP is in such great demand that the New York & Ohio Company will be obliged to operate its works in Warren, Ohio, with a double shift of men as soon as arrangements can be made to do so.

DESTROYED BY FIRE.—The plant of the Youngstown Bridge Company, at Youngstown, Ohio, was burned on the morning of September 22, entailing a loss of $85,000. About 175 men are thrown out of employment as a result of the fire.

THE WARD LEONARD ELECTRIC COMPANY, Hoboken, N. J., whose plant was recently burned, is reported to have leased buildings in Bronxville, where it will manufacture electrical appliances as soon as the necessary alterations are complete. About seventy-five men will probably be employed.

IMPROVING TRADE.—The Davis & Egan Machine Tool Company, Cincinnati, Ohio, reports a decided improvement in domestic trade. It has received more orders from this country during the past three weeks than any two months of this year. These orders come from all parts of the United States, showing a general resumption of trade.

A NEW ISOLATED PLANT.—The management of the Downing Building, a 15-story business structure, on Fulton Street, New York City, has decided to put in an isolated plant for supplying the lights in the building. The current has been hitherto supplied from the street mains. The E. G. Bernard Company, of Troy, N. Y., has been awarded the contract for the apparatus.

ENGINES FOR THE ARMOUR COMPANY.—The Murray Iron Works Company, Burlington, Ia., is building one of its well-known Sioux Corliss engines for the new Armour Company packing house at Omaha. This engine is to be of the cross-compound condensing type, of 300 horse-power, and its design and construction will embody all the late improvements in high-grade engines.

A TALKING MACHINE.—The Michigan Electric Company, Detroit, Mich., is handling a low-priced talking machine, which is practically a phonograph. It is operated by a spring clock-work motor, and it is stated that the musical and other records reproduced on talking machines of any pattern can be perfectly reproduced on this one. It is portable, and can be carried about without inconvenience.

ENGINE LATHES FOR THE FRENCH GOVERNMENT.—The Davis & Egan Machine Tool Company, of Cincinnati, Ohio, has just been awarded a contract by the French Government for four heavy 36-inch standard engine lathes with 22-inch beds. These lathes are to be equipped with metric lead screw and full set of change gears for cutting a large range of threads of the metric pitch. The lathes will be shipped from Cincinnati about December 1.

"ESSAYS UPON BOILER INCRUSTATION AND CORROSION" is the title of a complimentary volume issued by Mr. George W. Lord. The essays are carefully written, and include thorough discussions of the complex phenomena of internal boiler troubles. They also contain classified information about the care of boilers and the prevention of accidents, economy of firing, leaks, coverings, brickwork, etc. A copy of this book can be obtained by boiler users by addressing the office of Lord's Boiler Compound, 316 Union Street, Philadelphia, Pa.

A SATISFACTORY CATALOGUE.—The Electric Appliance Company, Chicago, has just completed the distribution of its latest edition of General Catalogue No. 12. Every mail brings a large number of complimentary letters from its customers, and the trade in general from all parts of the country. It is very evident that the style in which its catalogue has been issued is the one that is the most satisfactory to the trade, and the Electric Appliance Company will undoubtedly reap the benefits that naturally come from the exercise of the best judgment in matters of this kind.

THE PURITAN ELECTRIC COMPANY, New York, maker of the Puritan alternating enclosed-arc lamp, has, the better to handle the increasing Western trade, appointed as its representative, Mr. George Walker Conover, whose office is in the Monadnock Block, Chicago, Ill. Mr. Stuart W. Wise, president and general manager of the company, states that through its Boston agency it has just received an order from the Boston Electric Light Company for twenty-five of its new type alternating enclosed-arc lamps, which will be placed in the new East Armory, Boston.

STEAM HEATING.—The following-named contracts have been received by Warren Webster & Co., Camden, N. J., for the installation of the Webster system of steam heating for the purpose of giving greater efficiency and economy in connection with steam-heating plants, some of which are old buildings, while others are for new installations: Gale Shoe Manufacturing Company, Haverhill, Mass.; New Britain High School, New Britain, Conn.; Parker Block, Lowell, Mass.; Simon Silk Mills, Easton, Pa.; Minnesota State Prison, Stillwater, Minn.; South Boston Building, Wormwood and Binford Streets, South Boston, Mass.

THE GARVIN MACHINE COMPANY, Spring and Varick Streets, New York, has just issued list No. 20, of new and second-hand machinery, in stock for immediate delivery. The list of new machinery comprises, beside the company's own manufacture, many of the well-known makes of lathes, planers, shapers, drill presses, presses and shears, grinding machines; many miscellaneous machine tools and special bicycle machines. The second-hand list is nearly as complete, and has also a number of the company's well-known milling and screw machines listed, which are in as good condition as when new. The list will be sent to anyone desiring a copy.

THE EDISON MANUFACTURING COMPANY, 110 East Twenty-third Street, New York, has issued a new 64-page catalogue of its specialties. Among other things of interest to electrical engineers, is the Kennelly standard static voltmeter for high-tension direct or alternating service. The Edison X-ray apparatus also appears in a thoroughly worked-out and finished shape. It combines an instantaneous air-break wheel apparatus, a well-built induction coil, fluoroscope and tubes. A new form of the Edison combination direct and alternating-current transformer is listed in this catalogue. A small rotary transformer gives alternating current with a direct-current supply and an adjustable static transformer allows smooth graduations of the voltage to be made. An electrical centrifuge is also listed. This instrument is designed for the investigation of blood and bacteria. Many other interesting machines are listed, including therapeutic sinusoidal alternators and transformers.

MACHINE TOOLS.—Catalogue No. 33 of the Newton Machine Tool Works, Philadephia, just issued, is a very complete production of its kind. Illustrations of practically every machine made by the company and brief descriptions of the same are given, one page being devoted to one machine. This is a very handy arrangement of a catalogue, and will be appreciated by those who have occasion to refer to the book for information on any particular machine. By this arrangement the Newton Company is enabled to give good-sized illustrations of the machines, and consequently clearer ones as to the details of construction. The prospective purchaser, therefore, is better enabled to study the features of the machine he is thinking of buying. A very complete index accompanies the catalogue. The Newton Machine Tool Works produces army, navy, railway and general machine-shop equipment, and makes a specialty of metal-working machinery. Electrically driven tools of every description are also designed and built by the company.

HOW TO CARE FOR MOTOR CARRIAGES.—Directions for the care and advantageous operation of Mark III. Columbia motor carriages are given in a very neat pamphlet just issued by the Pope Manufacturing Company, Hartford, Conn. The Columbia motor carriage was described and illustrated in a recent issue of The Electrical World. In the new pamphlet the field of operation of the vehicle is set forth, together with a technical description of its constructive and operative features. The instructions for operation and care are very complete, and are given under various headings, including the charging and re-charging of batteries, and all the work in connection with their operation; starting, controlling, steering, braking, etc. Instructions are also given as to what should be done in case of accident to the vehicle. At the back of the book is given a long list of electric light central stations in the principal cities and towns of the Eastern States from which current can be obtained for charging the storage batteries. This pamphlet will no doubt stimulate general interest in motor carriages.

THE CARD ELECTRIC COMPANY, Mansfield, Ohio, reports the following orders recently taken: Seven 125-hp motors to Deere & Co., Moline, Ill.; one 22-kw generator to U. S. Baking Company, Charlestown, Mass.; two 25-hp motors to the H. J. Heinz Company, Allegheny, Pa.; one 20-kw dynamo to Hoover Brothers, Lima, Ohio; two 30-hp motors to Raton Coal & Coke Company, Raton, N. M.; one 30-kw generator and one 4-kw dynamo to the Shelby Electric Company, Shelby, Ohio; two 15-hp motors, one 10-hp motor and two 5-hp motors to Massillon State Hospital, Massillon, Ohio; one 150-kw generator to Elwood Street Railway Company, Elwood, Ind.; one 10-hp motor to Toebelman & Co., Galveston, Texas; one 15-hp motor to the Ohio & Pennsylvania Coal Company, Cleveland, Ohio; one 10-hp motor to the Cleveland Pearl Works, Cleveland, Ohio; one 40-kw dynamo to the Phalanx Silk Mill, Jersey City, N. J.; two 1800-gallon plating dynamos to Bennett & O'Connell, Chicago, Ill.; one 10-hp. motor to A. F. Spitler, Mansfield, Ohio; one 12½-kw dynamo to the Carre Lumber Company, New Orleans, La.; one 12½-kw dynamo to William Bailey & Son, Cleveland, Ohio; one 15-hp motor to the Cambridge Iron & Steel Company, Cambridge, Ohio; one 40-kw generator to the Wolverine Manufacturing Company, Detroit, Mich.; one 15-kw dynamo and one 7½-hp motor to the Link Belt Machinery Company, New Orleans, La.; one 7½-kw dynamo to Sport Plantation, Mt. Airey, La.; one 7-kw dynamo to Eiseman Brothers & Co., New Orleans, La.; one 40-kw generator to Decorah Electric Light Company, Decorah, Iowa; one 7-kw dynamo to J. P. Roof, Strongsville, Ohio; one 20-hp motor to Diamond Electric Company, Peoria, Ill.; one 20-kw dynamo to H. J. Johnson, Cleveland, Ohio; one 25-kw dynamo to the Jewish Orphan Asylum, Cleveland, Ohio; also several smaller machines. The Card Company informs us that its business is very good, and that it is securing an increasing number of inquiries concerning its apparatus.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., is doing a satisfactory business with its well-known dynamos and engines. Among the recent orders received by the company are the following: Schoen Pressed

Steel Company, Pittsburg, Pa., duplicate order, 50-kw generator direct-connected to 12x12 engine; New York & Pennsylvania Company, Johnsonburg, Pa., fourth order, 16x16 simple engine; Doylestown & Willow Grove Railway Company, two 14x23x18 tandem-compound engines, direct-connected to two 150-kw generators; City of McComb, Ohio, one 50-kw lighting generator; Cavanal Coal & Railway Company, Poteau, N. Y., one 13x14 simple engine; Knoxville Iron Company, Briceville, Tenn., one 16x16 simple engine; Hamilton & Co., steel works, West Newton, Pa., one 40-kw generator; City of Milan, Tenn., one 13x14 engine; City of Opelousas, La., one 14x14 engine; Black Diamond Coal Company, Coal Creek, Tenn., duplicate order, one 12x12 engine; Manning, Maxwell & Moore, New York City, 50-kw power plant, including direct-connected engine and generator; United Gas & Improvement Company, Philadelphia, Pa., one 10x10 engine; Scranton Electrical Construction Company, Scranton, Pa., one 12x14 simple engine and one 17x18 simple engine; Pennsylvania Railroad Company, one 150-hp engine.

A POPULAR SUPPLY HOUSE.—The volume of business transacted by an electrical supply house is generally reflected in the size of its catalogue. This rule, while not invariable, generally holds good. It applies well in the case of the Manhattan Electrical Supply Company, 32 Cortlandt Street, New York, which concern has just issued its illustrated catalogue No. 9. The 9 indicates the ninth year of the company's existence, as well as the ninth edition of the catalogue. Electrical supplies of all kinds are listed and well illustrated in the catalogue, which has grown to the dignified size of 304 pages. We cannot think of anything in the electrical supply line that has been omitted from the pages, and every branch of the electrical business is completely represented by illustrations and descriptions of apparatus in each branch. The Manhattan Company carries a very complete line of supplies for electric light, the household, the telephone and the telegraph. The Mesco dry battery is one of the company's well-known specialties. The rapidly growing popularity of this battery is indicated by a chart showing the sales of this cell during the years 1891-97. For the year ending July 1, 1891, the sales amounted to 3000 cells. They increased to 17,000 the next year, and in 1893 they reached 49,000 cells. The sales have been increasing at the rate of about 100 per cent. ever since, and for the year ending July 1, 1897 they aggregated 410,000 cells, making a total for the seven years of 1,052,000 cells. The catalogue, as a whole, is well gotten up, and great care was evidently bestowed upon its production. A very complete and convenient index is given at the back, which will enable the searcher for good things to find what he wants with the least trouble.

EXTENDING ITS FIELD OF OPERATION.—While having heretofore secured its share of foreign business, the C & C Electric Company, of New York, just now is showing that it appreciates the fact that there exists a rapidly increasing demand for superior American electrical machinery upon the part of nearly all progressive foreign countries, by sending representatives to several of these countries, who will open offices for the C & C Company and energetically push the sale of C & C apparatus. This week Mr. Paul K. Browd sails for Russia, where he will represent the company, as well as in Siberia. Mr. Browd, a native of St. Petersburg, now returns to his home after having spent some seven or eight years in the United States, during which time he not only took the full course in electrical engineering at Cornell University, but has gained a thorough practical experience as well in the electrical industry. Next week Mr. C. R. Heap, of London, returns home for the purpose of representing the C & C Electric Company in Great Britain, after having spent sufficient time in the United States to have enabled him to gain a thorough knowledge of and acquaintance with the company's electrical machinery and appliances, as well as its methods and practice. For several months, the C & C Company has been most actively and successfully represented in Kobe, Japan, by Mr. Lamar Lyndon, while it has also been securing considerable business through Mr. Joaquin Maiz, located at Monterey, Neuva Leon, Mexico, as well as through its Central American representative, Mr. C. F. Charliss, at Guatemala.

Business Notices.

SELLING AGENCY WANTED, G. Earlie, 150 Nassau Street, New York.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

TO EASTERN FARM RENTERS—Why pay rent year after year and have no farm when you get through? The landlord has your money and the farm at the end of the year. Why not go to South Dakota and buy a good farm with the money that you now pay for rent? You can get new, rich land near good towns on the Chicago, Milwaukee & St. Paul Railway, on easy terms, say from $5 to $10 per acre. Buy now and get a share of this year's crop. For full particulars write to H. F. Hunter, Immigration Agent for South Dakota, 295 Dearborn Street, Chicago, Ill.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 14, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

589,830. SECONDARY BATTERY; H. W. Headland, London, England. App. filed Feb. 11, 1896. In an electrode for storage batteries a metallic grid-like support for the active material, consisting essentially of a series of superposed open frames of polygonal form interconnected at their exterior and interior angles by connecting bars or posts.

589,832. ELECTRICAL SIGNALING DEVICE FOR USE ON PNEUMATIC CONVEYOR TUBES; G. W. Hook, London, England. App. filed Feb. 1, 1897. In a signaling device for pneumatic conveyor tubes, the combination with a trigger-arm provided with a convex side extending into the conveyor tube and pivoted within an air-tight chamber outside said conveyor tube; and a cam on the axis of said trigger arm, of a contact device adapted to be operated by said cam as said trigger arm swings on its pivot.

589,838. COIL FOR ELECTRICAL MACHINES AND METHOD OF MAKING SAME; B. G. Lamme, Pittsburg, Pa. App. filed April 17, 1897. The method of manufacturing bar windings for armatures of electrical machines which consists in forming a single flat bar of approximately uniform lateral dimensions into a loop, the arms of which are approximately parallel and lie in the same plane, then bending the respective arms in opposite directions about an axis which is parallel to the long portions of said arms and passes through the end of the loop.

589,839. ARMATURE FOR ELECTRICAL GENERATORS AND MOTORS; B. G. Lamme, Pittsburg, Pa. App. filed July 2, 1897. An armature for electrical machines comprising a core provided with slots and a winding located in said slots, said winding comprising an inner long bar and outer short bar in each slot, and end connectors bolted or riveted to the projecting ends of the bars.

589,842. METHOD OF MANUFACTURING ELECTRODE FOR SECONDARY BATTERIES; H. Leitner, Niederschonhausen, Germany. App. filed Jan. 23, 1896. The method of manufacturing electrodes for secondary electric batteries, consisting in finely powdering and intimately mixing about 95 per cent. oxide of lead with about 5 per cent. carbon; turning that mixture into a pulp by aid of a suitable medium; forming said pulp into a flat or curved plate by disturbing it upon a sheet of pierced lead, or upon a piece of lead network, letting the pulp become hard; reducing it to porous lead by exposing the plate to the action of an electric current and subjecting said plate to a high pressure.

589,845. COIL FOR ELECTRICAL MACHINES; J. P. Mallett, Pittsburg, Pa. App. filed Feb. 15, 1897. A coil for electrical machines comprising straight parallel sides of unequal length, the opposite faces of which lie in converging planes, and ends, each of which consists of a portion adjacent to the long side and approximately perpendicular thereto, and a longitudinally inclined portion joining said perpendicular end portion with the short side.

589,865. SWITCH FOR ELECTRIC CIRCUITS; H. B. Shallenberger, Rochester, Pa. App. filed May 26, 1897. A switch for electric circuits comprising a suitable base provided with stationary terminals, a movable contact member having one end bent to form a bow-spring and means for pivoting said spring end to one of the stationary terminals.

589,891. ELEVATOR CONTROLLER; M. W. Day, Schenectady, N. Y. App. filed June 12, 1897. In an electric controller, the combination of contacts for connecting the motor with the source of supply, means for disconnecting the motor from said source and connecting a resistance across the mains, and means for shunting the armature by a portion of the resistance.

589,893. AUTOMATIC SWITCH FOR SURFACE CONTACT RAILWAYS; E. M. Hewlett, Schenectady, N. Y. App. filed Jan. 25, 1897. In a surface-contact railway system a car provided with a storage battery, means for turning the car, and an automatic switch for reversing the battery connections.

589,894. SURFACE CONTACT RAILWAY; E. M. Hewlett, Schenectady, N. Y. App. filed May 27, 1897. In an electric car the combination of motors, a battery and contact shoes connected thereto, with an auxiliary shoe, an automatic switch in circuit therewith acting to open the battery circuit upon grounding the auxiliary shoe, and a switch for reversing the leads to the contact shoes while the battery circuit opens.

589,897. BELL; S. Jevons and W. Collins, Birmingham, England. App. filed Oct. 28, 1896. The combination with two bells, a single hammer arranged between them and common to both, a single armature attached to the hammer, a pair of magnets arranged to act on the common armature, contact pillars, one on each side of the armature, the contact springs carried by the armature, a circuit and push button for each magnet and contact pillar and a double push button independent of the two first mentioned and adapted to be located at any desired distance therefrom with circuit connections for closing both circuits to energize both magnets and sound both bells from the common hammer.

589,904. DYNAMO BRUSH HOLDER; J. A. Marsh, St. Louis, Mo. App. filed Jan. 9, 1897. An improved dynamo brush holder having a casting provided with a slot adapted to be fitted over a quadrant bar of a machine, a casting movably secured to the casting held to the quadrant bar, a bar adjustably secured to said movable casting, a clamp placed upon the end of said bar, said clamp carrying a brush, said movable casting regulated by a spring, said spring connecting both castings.

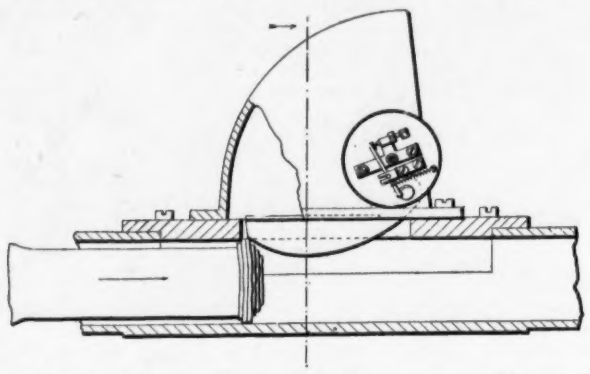
589,938. ELECTRICAL CIGAR LIGHTER; T. C. Dobbins, Telluride, Col. App. filed May 11, 1897. The combination of a block having rows of insulated metallic pegs therein, the pegs in the alternate rows being electrically connected and adapted to be oppositely polarized, with a separate metallic igniting device constructed to be drawn across the surface of said pegs to create a series of short circuits, and thereby cause an ignition of the material on the igniting device.

589,996. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed July 28, 1896. In an electric arc lamp a magnet constructed with two

salient poles of one and the same polarity and an intermediate or consequent pole of polarity different from that of the salient poles, and an armature pivotally supported by the intermediate or consequent pole and adapted to be turned on its fulcrum by the salient poles.

590,000. MOUNTING FOR COMMUTATORS OF DYNAMO ELECTRIC MACHINES; E. Caemmerer,. Chicago, Ill. App. filed May 13, 1897. The combination in a dynamo electric machine, with the commutator of the commutator frame supporting said commutator, but electrically insulated therefrom, and an insulating mounting interposed between the commutator frame and the supporting part of the dynamo electric machine.

590,050. ELECTRO-MEDICAL EXERCISING APPARATUS; W. A. Webb, Brooklyn, N. Y. App. filed June 2, 1897. The combination in an electro-medical exercising apparatus, of a battery, a case containing a cir-

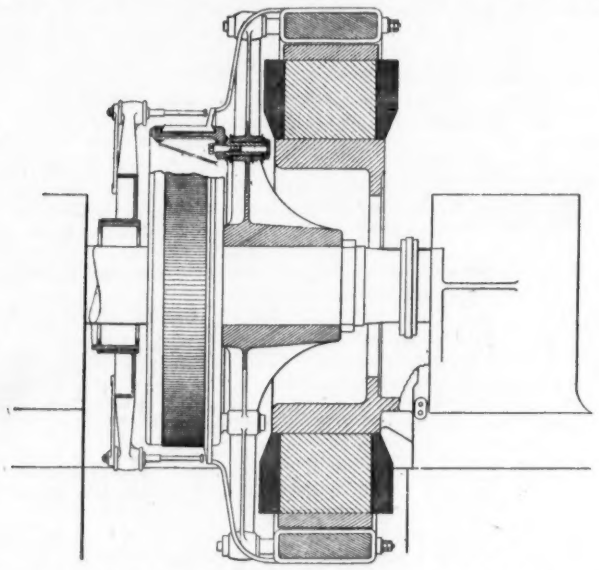


No. 589,832.—Electrical Signalling Device for Use on Pneumatic Conveyor Tubes.

cuit breaker, circuit connections for adapting said battery and case for suspension at the rear and front, respectively, of the person's body, and an exercising device in partial circuit with the circuit breaker to be in closed circuit therewith when grasped.

590,082. TROLLEY AND CONDUCTOR FOR ELECTRIC RAILWAYS; T. Von Zweigbergk, Cleveland, Ohio. App. filed Jan. 30, 1897. The combination of a conductor and diverging conductors all held in the same approximately horizontal plane, except that at and near the point where said conductors would meet they are turned out of their normal course, whereby the trolley path is interrupted and the trolley arm allowed to ascend somewhat, combined with a trolley arm and two grooved contact devices, carried one in advance of the other by said trolley arm, one of said contact devices being below the other when the trolley arm is in normal operative position.

590,098. ALTERNATING CURRENT GENERATOR; H. Fairbanks, St. Johnsbury, Vt. App. filed March 6, 1897. A continuously magnetized field magnet, having its poles facing each other, each pole divided into two or more equal pole divisions, alternately right and left-hand wound with gener-



No. 590,000.—Mounting for Commutators of Dynamo-Electric Machines.

ating coils, separate inductor masses reaching nearly across between the poles, and each substantially of the size of the presenting end of one of said pole divisions and a non-magnetic carrier arranged in one position to present the said inductors fairly to all the right-hand wound pole divisions, directing the magnetic flux through them, and in the next position to present these inductors to all the left-hand wound divisions, directing this flux in the same way through them, whereby an alternating current is induced in the said generating coils.

590,120. CONDUCTOR; J. Swinburne, London, England. App. filed Feb. 11, 1897. An electric conductor made of electrically deposited zinc, compressed to increase its density and tenacity.

590,136. TELEPHONE EXCHANGE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Nov. 3, 1896. The telephone lines, each provided with a switch at the subscriber's station thereon, and at the central office switching devices for uniting said lines in combination with a signaling generator adapted to be closed to the called subscriber's line when the lines are united, an electromagnetic circuit-charging device provided with two windings or helices, one winding being connected with the generator circuit and the other being connected in a local circuit containing two openings and a source of current, one of said openings being closed when the lines are connected together, the switch of the called subscriber when operated being adapted to reduce the resistance of the circuit containing the signaling generator, to increase the current traversing said coil connecting with said generator, to operate the said electromagnetic circuit-changing device, to close the other opening of the local circuit, and immediately thereafter to open the connection between the generator and the coil or winding of the electromagnetic circuit changing device connected therewith.

590,137. TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed Sept. 28, 1896. In a telephone exchange system the combination of line wires leading from a central office to subscribers' stations, with calling apparatus at the subscribers' stations, a calling generator, an electromagnet adapted to include said generator in circuit with the subscribers' calling apparatus, means operated by the called subscribers' apparatus for removing said generator, and apparatus at the central office for exclusively controlling the operation of said electromagnet, whereby its operation by substation apparatus is prevented and false signals obviated.

590,141. TROLLEY WIRE HANGER; J. F. Faulkner and R. Campbell, San Antonio, Texas. App. filed March 8, 1897. In a trolley clamp the combination of a rigid jaw having a slight dip to receive the wire; with a sliding jaw, having a lip at its outer end to engage the trolley wire and adapted to slide upon the rigid jaw, and means for holding the two jaws together and for holding the sliding jaw into contact with the wire and for clamping the wire between the two jaws, the entire structure being such that any rupture of the mechanism for holding the two jaws into contact with the trolley wire, will cause the clamp to fall off from the trolley wire by reason of its own automatic separation.

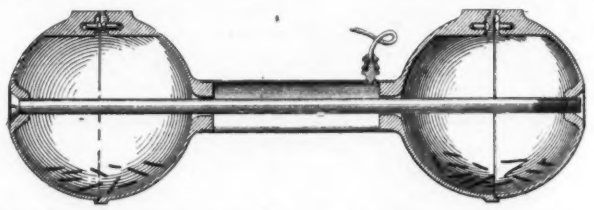
590,151. SECONDARY BATTERY; G. Hart, Detroit, Mich. App. filed Jan. 14, 1897. An electrode for a secondary or storage battery, consisting of two similar sheets of metallic lead, each sheet having half cells formed by walls integral with the said sheet, the side walls converging toward the latter from the open top of the trough to its bottom, the two plates being united with the half cells, registering adjacent series of said cells being separated by plane vertical portions of the united sheets, which are united when the two plates are brought together.

590,166. TROLLEY GUARD; H. C. Reed, Minneapolis, Minn. App. filed March 16, 1897. The combination with a trolley, of a retainer rotatably mounted and having projecting parts or arms to extend across the trolley and retain the line wire in engagement therewith, and adapted to turn to clear a line support or like part.

590,171. ELECTRIC BATH; J. J. Stanger, Stuttgart, Germany. App. filed March 6, 1897. The combination of a bath having outlet wooden racks arranged one at each side of said bath, electric connection to said racks and bars or a frame arranged over said bath, and a cloth to cover said bars.

590,185. TELEPHONE EXCHANGE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed July 2, 1897. In a telephone exchange system the combination with a telephone line having a switch and a signal bell at the subscriber's station thereof, of a circuit independent of said telephone line, an electromagnetic circuit-controlling device connected in said circuit, means governed by said switch for changing the electrical condition of said circuit, whereby the operative condition of the electromagnetic circuit-controlling device may be altered, switching apparatus at the central office for uniting and disconnecting telephone lines, a calling generator and a calling switch adapted to be operated by said circuit-controlling device to include the generator in a circuit with the signal bell at said station when the condition of said independent circuit is normal or unchanged by the operation of the switch at the subscriber's station, said switching apparatus being adapted to associate said calling switch with the telephone line upon being manipulated to connect subscribers for conversation.

590,186. TELEPHONE SYSTEM; W. W. Dean, St. Louis, Mo. App. filed July 12, 1897. In a telephone exchange system, the combination with a plurality of telephone lines extending from subscribers' stations to an exchange, each subscriber's station being provided with a signal bell, of



No. 590,050.—Electro-Medical Exercising Apparatus.

switching apparatus at the exchange for uniting subscribers' lines for conversation, a calling generator, a calling switch adapted upon being actuated to include the generator in circuit with the bell at the called subscriber's station, a detent adapted to engage and maintain the calling switch in the position to which it has been actuated, whereby the generator is maintained in circuit with the called subscriber's bell, means for disengaging said detent and calling switch, apparatus provided at each station, each apparatus being adapted when its station is the called station to operate said means to disengage the detent and switch, and means for restoring the calling switch to its normal idle position when thus disengaged.